Editorial

THE influence of recorded sound on our daily lives is assuming quite colossal proportions. No-one today can avoid it. Whether through the radio, or the rapidly increasing flow of phonograph records, more people are hearing more sounds than ever before. These are made possible by developments in methods of recording, of which the magnetic tape is now firmly established in the background.

As frequently happens when large-scale consumption becomes possible, the flexibility and general possibilities of tape recording are being exploited to the full. Popular records now use as almost standard technique methods which began as stunts, but which now regularly expand and amplify beyond belief.

There is nothing wrong with the addition of "echo" effects, for instance, to brighten up the efforts of pop singers and instrumentalists, swing bands and so on. Such records live or die on their over-all interest. At the moment, we have half-a-dozen ruling kings and queens whose voices are given artificial reinforcement which is the touchstone of their sales appeal. No doubt this craze will pass, but it will be replaced by some new fashion depending more and more on the ingenuity of the recording engineer. With his multiple recording heads and editing facilities he can leave the old disc technique in the shade.

I sometimes wonder whether the temptation to popularise their records isn't leading more serious performers to play the gallery at the expense of their musical worth. Those who are interested in classical music will buy good records supported by good names. But the temptation to "lay it on" to catch the more popular ear is, I fear, having a subtle but unmistakable influence even upon the select band of stars. It would be a pity if this influence got out of hand. We might have more glamorous recordings, but musically they might not be so good.

Those who must use new and somewhat more complex recording and playback equipment, too, seem to be showing the strain here and there. Recently I heard a 33 rpm record from the ABC which was obviously played by a luckless announcer at 45 rpm all through one side, with rather tragic effect. A tape machine from another station ran riot with a mixture of speeds which was even worse.

Equipment these days must be above reproach to meet our somewhat blase standards. An ABC tape machine used to record and playback concerts has recently developed a most annoying unevenness, revealing a degree of piano whine not to be tolerated in performances of this type. On the other hand, I don't know whether some change has been made in the microphones or their placement from the Sydney Town Hall, but the broadcast concerts these days are remarkably good.

Every new device makes new demands on its users. We must be careful to see that the instrument doesn't become more important than its master—that it remains a means to an end and not an intruder in the process of what we receive and what we can expect to hear.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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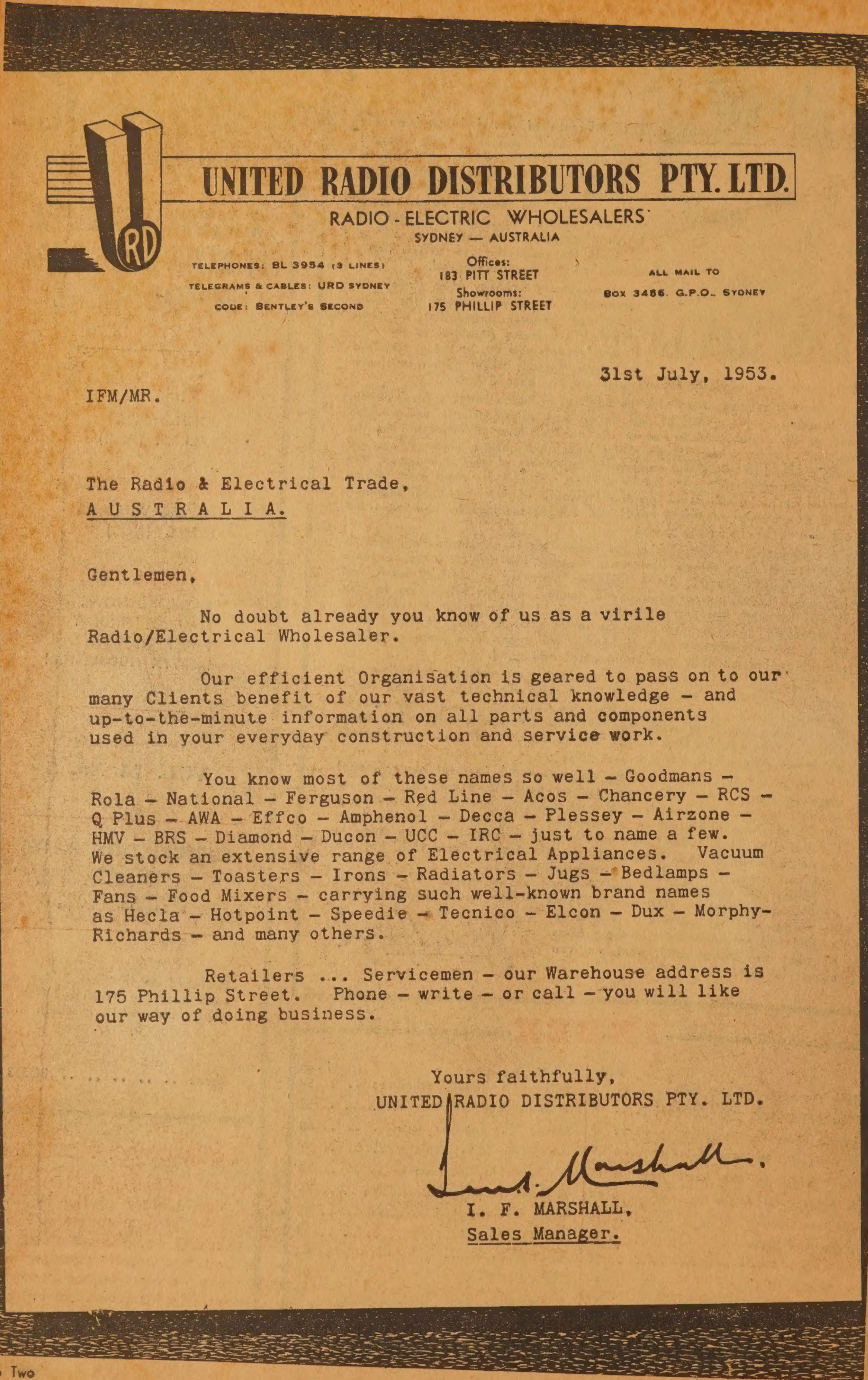
OUR COVER PICTURE

An assistant at the National Film Library of the British Film Institute compares two copies and the sound track of an early sound film, keeping a careful watch for scratches and tears. See p. 7.



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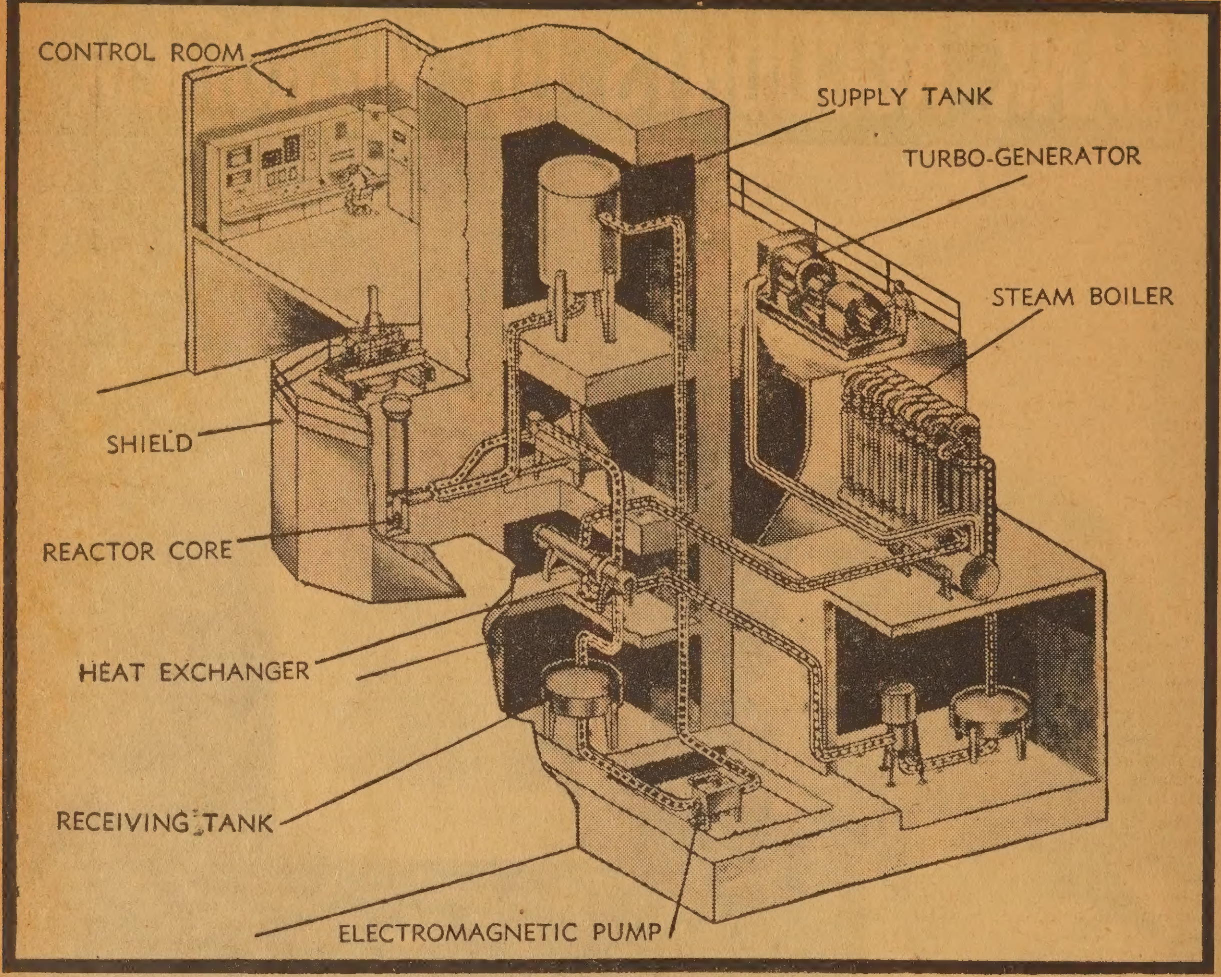
I. F. MARSHALL,
Sales Manager.

BANK ACCOUNTS ON MICROFILM

From small beginnings in 1861, the British Post Office Savings Bank has become the largest organisation of its kind in the world. Ledgers and documents dating back more than 50 years present a serious storage problem but the information they contain is now being transferred on to microfilm. Records stored in this way can be examined quite easily on the special microfilm projector.



How the "Breeder Reactor" works, illustrated by this cut-away drawing of an experimental power generating plant. Heavy lead and concrete walls and partitions serve to protect personnel against dangerous radiation.

NEW ATOM PLANT "BREEDS" FUEL

Though they gained only a small mention in the world press, two recent announcements from atomic laboratories in the United States will have far-reaching significance. One was the announcement of the atomic fuel "Breeder". the other of the new "Homogeneous Reactor".

BOTH look like being very important.

The significance of the "Breeder" reactor is that it will most likely solve one of the outstanding current problems — the relative scarcity of the only two known fissionable materials, plutonium 239 and uranium 235.

A continuing supply of one or the other has been considered essential for the operation of an atomic power plant.

With the new principle, once having "stoked" an atomic furnace with the requisite amount of fissionable material, is can be kept going indefinitely by adding appropriate quantities of ordinary non-fissionable uranium.

Far from using up the original quantity of uranium 235 or plutonium 239, the "furnace" should theoretically produce a surplus of fissionable material which can be withdrawn at intervals and used for other purposes.

The atomic breeder works something like this: The initial fission takes place in a central core about the size of a regular football. This core contains uranium 235 or plutonium 239, together with a moderator element to control and limit the action.

Around the central core is placed a blanket of natural non-fissionable uranium.

Controlled fission takes place in the normal way, generating enormous heat. At the same time, neutrons liberated during the process convert atoms of the natural uranium into plutonium, which then becomes subject to fission. The action continues until all the available natural uranium has been consumed.

Theoretically, at least, more plutonium can be "bred" than is necessary to maintain the plant in operation, but whether this can be achieved in practice has not been revealed.

COMPLETE PLANT

A diagram released by the Atomic Energy Commission explains the operation of the complete atomic power unit which is now in operation and generating 250 kilowatts of electrical power. It follows the work which produced the world's first industrial atomic generator in December, 1951.

In the reactor core, at the left, uranium 235 (or plutonium) works on a blanket of non-fissionable material surrounding it to "breed" or produce plutonium.

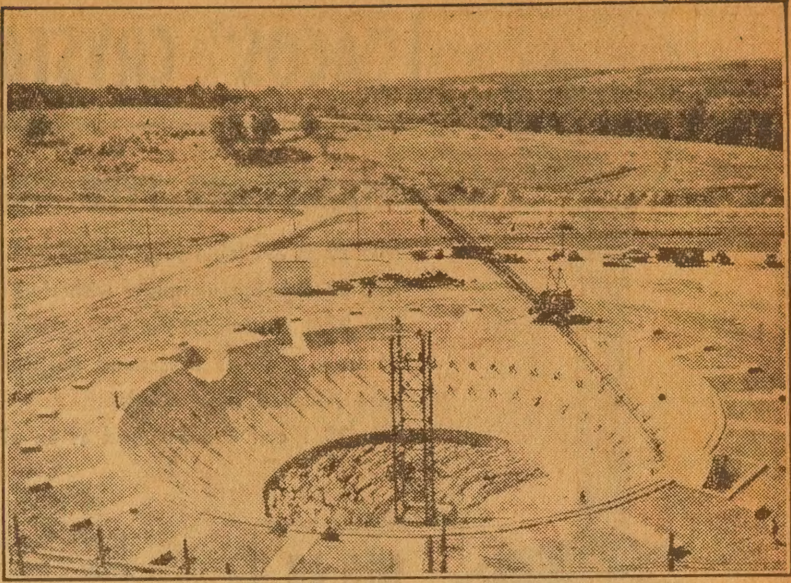
This action goes on inside a double-walled tank containing a sodium-potassium-alloy liquid, serving to carry away the heat generated. The tank is surrounded, in turn, by a neutron reflecting shield and an outer shield of lead and concrete to stop dangerous radiation.

The sodium-potassium primary coolant flows through pipes to a heat exchanger, thence through a receiving tank to a magnetic pump, which returns it to a gravity supply tank at the top.

Because it has passed through the fission chamber, the primary coolant is radioactive and must be treated accordingly.

Instead of being used directly, it transfers its heat to another sodium-potassium circuit or secondary coolant, which can be kept non-radioactive.

This, in turn, passes through a steam boiler circuit to produce superheated steam for the turbines. After use, the steam is condensed again and returned to the boiler.



This huge saucer-shaped structure in a field outside Schenectady will house the prototype submarine atomic power plant which the General Electric Company is developing for the Atomic Energy Commission. Measuring 179 feet in diameter, 42 feet deep and set in a 4000 acre site, the spherical building is intended to minimise damage in the remote event of the atomic reactor getting out of control.

SIZE PROBLEM

Meanwhile, another team at the Oak Ridge research centre have achieved what would appear to be a major forward step in reducing the size of an atomic power generator. This problem has hitherto seemed to limit atomic power to use in fixed locations or at least nothing smaller than a very large submarine.

The Oak Ridge team's new scheme is their "Homogeneous Reactor". Announcing it, Dr. Alvin Weinburg, head of the laboratory, said, "This could turn out to be the most important achievement in Oak Ridge since the war—and one of the most important to come from any of the atomic facilities in the country."

This plant, which is now generating about 150 kilowatts of electrical power, is described as being "extremely small" by current standards.

A similar reactor, developed at the Los Alamos bomb-making centre in New Mexico, has been nicknamed the "table model" reactor. While this is admitted as an exaggeration, it is suggested quite seriously that comparable power has never before been produced in such a small space, other than in the atom-bomb itself.

JUST THE OPPOSITE

The homogeneous reactor is basically different in design from existing power plants—in fact it is the direct opposite in principle. As a result, the Oak Ridge team facetiously refer to it as "Ocra", which is just the reverse in spelling of Arco, in Idaho, the centre which has developed the more conventional plants.

In all these, the fission materials are kept separate from the coolant circuit which conducts the heat away, ultimately to produce superheated steam. The principle is seen quite clearly in the illustration of the breeder reactor.

In the new Oak Ridge plant, however, the uranium, the moderator and the cooling liquid are all lumped together in what is facetiously described as a single "brew".

The action is instantaneous and continuous and is supported occasionally by the addition of extra fissionable material. A magnetic pump keeps the "brew" moving at all times and, at one point in the cycle, the heat is used to produce superheated steam for the turbine generator.

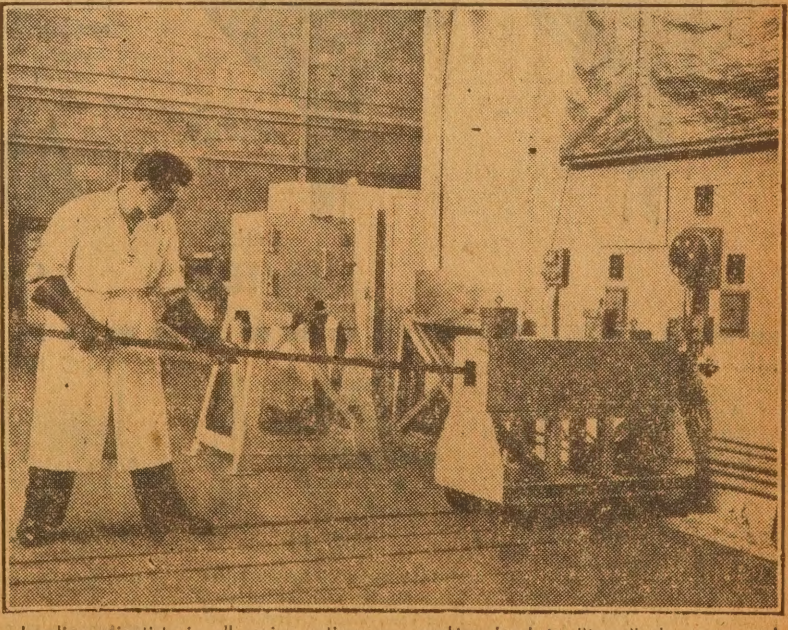
Advantages claimed for the homogeneous reactor are that it is simpler to run—or it should be when fully developed—it is smaller than other types and probably cheaper.

Despite this, however, the question of cost is one of the discouraging features of atomic power plants at the moment. Present estimates, for what they are worth, put the cost of a "packaged" atomic plant at from 3 to 5-million dollars. A full-scale central power plant might run from 50 to 150-million dollars.

Ideas that atomic generating plants will rapidly cut the cost of industrial power are also discounted by responsible engineers.

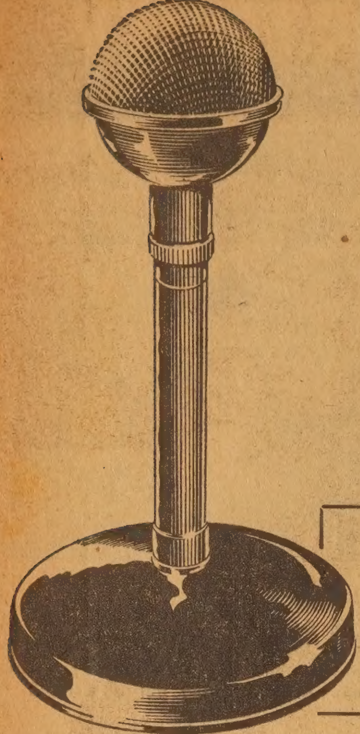
They point out that an atomic power generating station is basically similar to the ordinary variety except that it "burns" small quantities of fissionable material rather than huge quantities of oil or coal. But thermal requirements represent only 20 pc of the cost of bulk power and savings in this department can have only a secondary effect.

The strong attraction of atomic power is in locations where normal fuels are hard to obtain and in ships and planes where the enormous fuel load limits the carrying capacity and the range.



Leading scientists in all major nations are working hard to "tame" the atom and put it usefully to work. Here a worker is withdrawing radioactive materials from an atomic pile "Le Centre Nucleaire"—a new French research centre at Saclay.

"ACOS" CRYSTAL MICROPHONES



MICROPHONE TYPE MIC 22

Mic 22 is available in 2 types.

Mic 22/2 being complete with desk stand as illustrated.

Mic 22/1 consists of the microphone with nickel plated stem at the end of which is fitted a screwed adaptor which will fit British or American type standard floor stands.

Mic 22/1 can also be used as an effective hand microphone.

MIC 22

PRICE

£9/18/6

SPECIFICATION

Output impedance . . . Equivalent to approximately .002 MFD. (.8 megohm at 100 cycles)

Omni-directional.

Frequency response . . . Substantially flat from 40 to 6,000 cps.

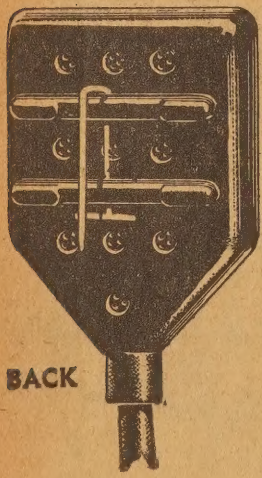
Recommended load resistance . Not less than 5 megohms

Output level . . Minus 50 db below 1 bolt/bar.

MIC 28 LAPEL MICROPHONE

Impedance 100,000 ohms at 1,000 cps.
Capacity .0015 mfd at 24 deg. C.

Output level approximately .55db. Ref. 1 volt/dyne/cm2. Recommended load resistance not less than 5 megohms. This small non-directional microphone has been designed to allow freedom of movement for public speakers or broadcasters. The dimensions of the MIC 28 are 1 9-16in. wide by 2¼in long by 5-8in thick. It is housed in a soft moulded rubber case which gives added protection against shock. The microphone hooks on to the lapel of a suit or coat. A 6' cable is supplied. The MIC 28 has a level frequency response throughout the whole of the audible frequency spectrum, and consequently gives excellent fidelity of reproduction.



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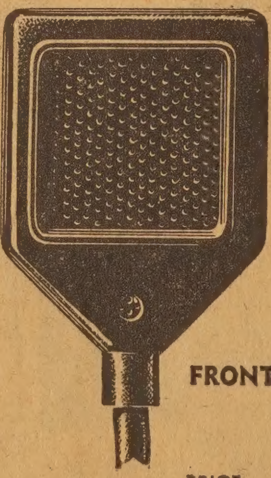

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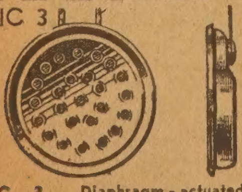
MIC 3

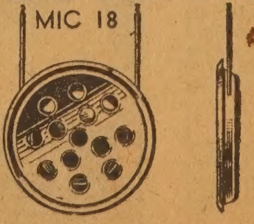


MIC 3. Diaphragm-actuated Crystal Microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price 39/3.

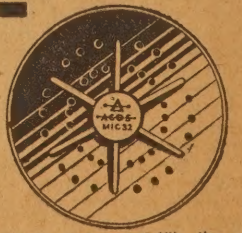
MIC 14

MIC 14. Standard Speech Microphone itself, with nickel plate brass case, which gives high corrosion resistance, mechanical strength and rigidity. Price, 39/3.

MIC 18



MIC 18. Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this insert is recommended. Price, 39/6.



MIC 32. Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 30-7000 c/s. Unaffected by vibration, exceptionally robust construction. Price, £2/15/6.

SAVING FILMS FOR POSTERITY

The tele-cinema built for the Festival of Britain display has now been made available to the National Film Library for exhibiting films of special historical and dramatic interest. These are stored, in the meantime, in specially air-conditioned chambers to minimise deterioration with age.

by Roger Manvell

EVEN in these days of economic austerity, Britain has managed to set up a National Film Theatre, dedicated solely to demonstrating the history and art of the film.

The existence of such a theatre in London has been the dream of many who have either worked at or worked with the British Film Institute and its special department, the National Film Library, and luck was in their favor when a small tele-cinema was built mainly to demonstrate three-dimensional films and big-screen television during the Festival of Britain in 1951.

This tele-cinema has become the National Film Theatre of today, operating under the supervision of the British Film Institute, a government-sponsored organisation set up nearly 20 years ago to promote the study and preservation of films.

One of the main problems for people genuinely interested in the cinema (and their numbers grow every year in most countries) is that of how to see old films.

Setting the hygrometer (for recording humidity) and the thermograph (for recording temperature) in one of the film vaults of the National Film Library. Here copies of films are stored which are likely to be of interest to future generations. Temperature is kept constant at 55 degrees F.

NO REVIVALS

The commercial cinema circuits, having to satisfy a weekly or bi-weekly audience, are mainly interested in the latest productions, which come and go with great rapidity, and may never be seen again except in small and sepecialised theatres, Miss a masterpiece on its first exhibition, and the chance to see it may be lost for ever.

How different from books, which the library places at the reader's disposal when he needs them, or the living theatre, where, in many of the great cities at least; companies revive outstanding plays of the past as regularly as they put on new productions.

The print of a film is delicate. A book well looked after lasts hundreds of years; but the print of a film may only last 50 years, even if it is preserved under the most scientifically-controlled conditions.

That is why preservation centres for films have been founded in a number of countries (including Britain, the United States of America, France and Italy), and why, in the past 15 years, research into the best methods of collecting, storing, and preserving films has been undertaken, notably by the National Film Library of the British Film Institute in London and by the Library of Congress in Washington.

I myself have served for a number of years on a committee of the National Film Library, which meets every month to recommend those contemporary films which, for artistic reasons or for their value as a record of our social life, should be preserved.

This committee also receives reports on the old films already stored in the institute's vaults at Aston Clinton, some 40 miles outside London.

The committee has to reach a decision about those films which are reported to have reached the danger point in deterioration, and to advise their being reprinted on new film stock, or, if they seem worthless, to advise their destruction.

Several thousand pounds are spent each year on reprinting films which seem likely to be of interest to future generations of students of the film, or, for that matter, students of the arts, sciences and historical conditions of the past which they record.

The student can always view these films by himself on a movieola (a machine which produces a small picture suitable for viewing by one person), but the ideal situation is that all films of value and interest from the past should be revived and shown publicly in a cinema specially devoted to that purpose.

REVIVAL PROGRAMS

This is now being done in an organised series of programs at the National Film Theatre.

In addition to maintaining the work of the National Film Library, the British Film Institute, as an independent body supported by an annual grant, is responsible for many other public activities connected with films.

It has a large library and information centre which any member of the public is at liberty to consult. It has a department concerned to develop film appreciation throughout the country, particularly in schools and colleges and for adult organisations like the film society movement, which is now widespread in Britain.

It has a publications department, mainly responsible for the institute's

(Continued on Page 104)

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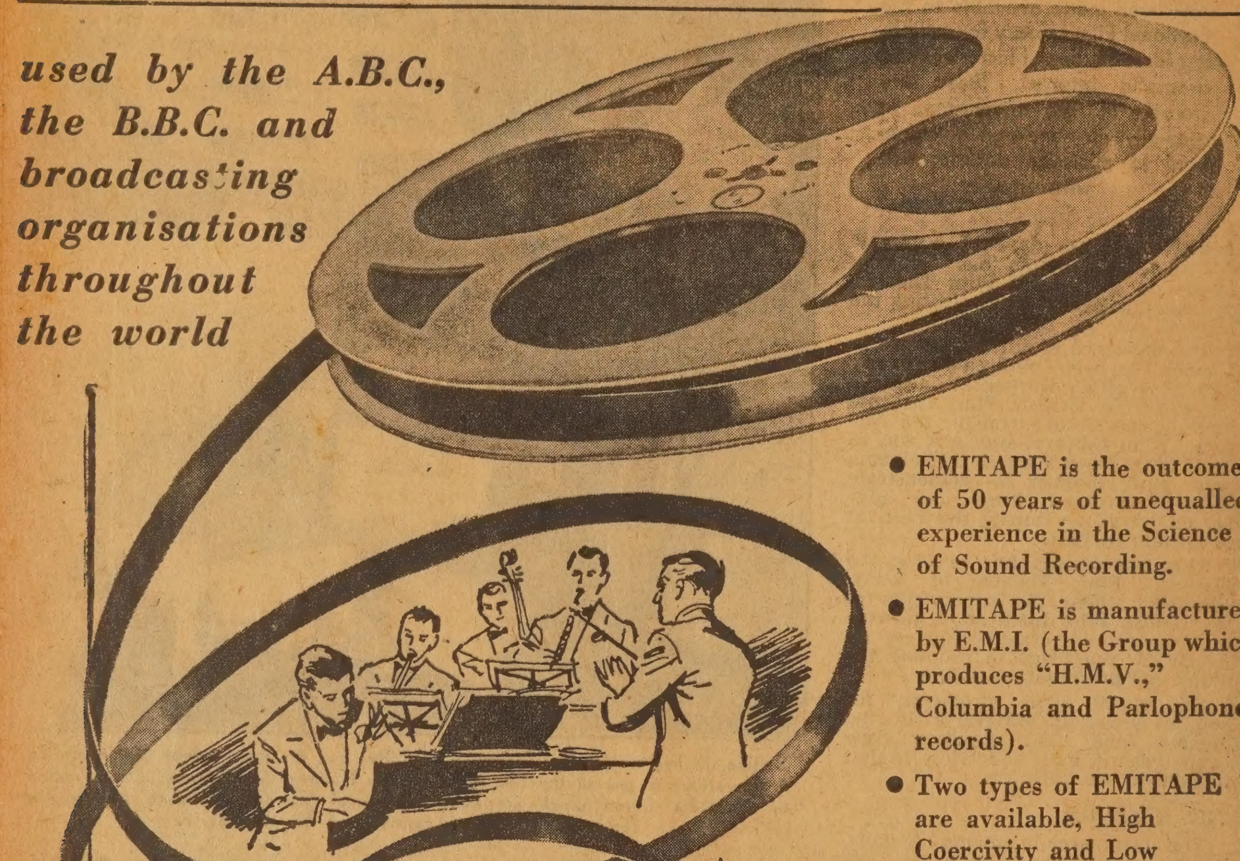

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FLEW PACIFIC 25 YEARS AGO

In these pages most of our articles tend to lean to the future telling the story of scientific progress in many fields but in this article a Melbourne correspondent, Roth Jones, has put the clock back 25 years to the first air crossing of the Pacific Ocean. It makes interesting reading when we think of the rapid progress made by aviation and radio communication and radio aids to air navigation in the swift flowing intervening quarter of a century.

by Roth Jones

SOUTHERN California's early summer sun shone brightly on the tately three-engined Fokker, the outhern Cross, 25 years ago this ear (last May), as it winged its way westward over San Francisco's Golden Gate bound for Australia.

And in the hundreds of amateur adio "shacks" scattered throughout he world and in many countries housands listened for the signals of position from James Warner, Amerian radio operator taken by the late Sir Charles Kingsford Smith in this famous flight.

RADIO STORY

The signals which came from this man, and there were many and they came frequently, told a thrilling tale and proved to the world that radio was an essential aid to long-distance flying.

The achievement of the flight and of Kingsford Smith and his three companions slips easily into a prominent niche in the hall of flying fame among the greatest flights of all time.

Few of the pioneering flights that thrilled the world a quarter of a century ago have remained so vividly in the Australian and American mind, especially among the veteran members of the amateur radio fraternity, than this striking three-hop 7347-mile dash from Oakland, California, to Brisbane, Queensland.

It was airmanship of the highest order, brilliant dead-reckoning navigation by Warner's American colleague, Harry Lyon and a bold and very successful experiment in the use or radio as an aid to long-distance flying for navigation and communication.

Much of the success of the Australian-American air link today, one of the busiest air highways in the world, is due to the two Australians and two Americans who dared all to conquer the Pacific and succeeded.

MODERN AIDS

On the small islands which dot the route have sprung up modern, well-equipped radio and meteorological stations guiding the civil aircraft on their journey. During Kingsford Smith's flight these islands, the majority inhabited only by natives, were pin-points for navigation.

Few of the world's air highways have as an efficient radio system of communication and aid to navigation than the Transpacific route developed largely by the Royal Australian Air Force and the American Air Force during the South-West Pacific campaign.

Today, sleek modern Stratocruisers and DC6's follow the trail blazed by Kingsford Smith and his companions. It has become an essential link for the development of commercial and industrial relations between the two nations — a pathway for scientific and cultural exchange between Australia and America.

But let's put back the clock 25 years and keep it there for a while as we think of the pioneers and how much we owe them today for their courage, perseverance and enterprise.

The critics of aviation — and they were in the majority in those pioneering days—scorned the flight. They claimed it to be dangerous, unnecessary and unlikely to be of any use in the future.

The American Press stated such "futile" attempts damaged the growing public confidence in aviation. Politicians and the numerous self-styled experts whipped up public opinion against the flight. The four pioneers had a tremendous psychological burden to carry.

As one prominent flying man in a letter to an Australian newspaper stated, "Selection of a Fokker because it is the safest machine is all nonsense. It is a land machine and for a flight across the Pacific the only practical type is a seaplane. Where are you going to land? After Honolulu the sea is studded with small archipelagos, and there is not one decent landing place."

The crew took the newspaper controversy calmly as they prepared for their flight early in 1928. They were too busy checking their instruments and equipment to bother about it. They had faith in themselves, their aircraft and their instruments and set out to prove an aircraft could link Australia with America.

CONFIDENT START

Once they were airborne and away from the hurly-burly of the growing aviation world, they were their own masters. Kingsford-Smith and Ulm sat in the cockpit alongside each other with Lyon and Warner busy manipulating their instruments. During the early stages of the flight they were full of cheer, happy and confident. Later, dwindling fuel supplies and tropical storms created the fear and uncertainty which is dreaded by all airmen.

Approaching Hawaii, spirits were still high as the three Whirlwind engines droned monotonously 5000ft above the ocean.

Unfortunately the good weather was not to last. Shortly after leaving Honolulu on the 3144-mile leg to Fiji, Kingsford-Smith wrote:

(Continued on Page 11)

SOUTHERN CROSS

The "Southern Cross", most famous plane in the history of Australian aviation, photographed over New Zealand.

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No 3—Bass control, rise and fall.
No. 4—Treble control, rise and fall.
No 5—Input selector, 5 positions.
    Position 1: Radio.
    Position 2: LP records.
    Position 3: 78 American records.
    Position 4: 78 European records.
    Position 5: Microphone.

20 Millivolts input to pick-up terminals for 20 Watt output.

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"The windshields began to leak and water started to trickle in on us. We were both very wet around the feet and legs. It was a breathless race between the Southern Cross and the clouds."

Nearing Fiji, after 30 hours in the air, fear gripped the crew. Headwinds had reduced speed considerably and fuel supplies were considered low.

"Seven o'clock, flying blind again; eight o'clock, bucking into a headwind; nine o'clock, still fighting the wind, scurrying through the rain and getting many a jolt. Our rosy hopes of making Suva faded a little. Ulm instructed Warner to send out our position on short-wave regularly."

SUFFICIENT PETROL

Fortunately this fear was shortlived. There was more petrol in the tanks than the gauges had recorded.

"Ten o'clock saw us ready to whoop for joy. We found we had seven hours' fuel left. Then Ulm sighted Fiji."

Oddly enough, the shortest leg, the 1795-mile stretch from Suva to Brisbane, was the most hazardous of the journey.

"There seemed menance ahead after eight o'clock. It grew steadily colder. Gusts bumped us a little. The stars were gone and the cloud fringes trailed ahead.

"Soon after 8.30 pm the storm leaped on us in its fullest fury. Rain storms charged at us. Battering on the windshields increased. There was no lull. We flew in a black void. Raking winds jolted the plane.

"It was nearly midnight before that first merciless storm waned. In the next four hours less severe storms swept down on us and we had to dodge up and down between 500 and 9000 feet with more patches of blind flying."

Kingsford-Smith and Ulm were acclaimed national heroes when they finally brought the Southern Cross down at Brisbane shortly before 10 am on June 9, 1928. The two Americans who had shunned most of the publicity during and after the flight had also made a notable contribution to international aviation.

Warner's contribution has perhaps become more significant as international aviation has developed. He battled with his radio direction finder to obtain bearings from ships and fixed shore stations, more to prove its reliability than to give his skipper a bearing. When it worked, it seemed to work well but there were times when it was completely inoperative.

TAKE YOUR PICK

As Warner told a colleague in Sydney after his flight, "When it works, it's swell; when it don't, it just ain't".

Not the least remarkable phase of the crossing of the Pacific by air was the fact that throughout the entire time of the flight, the Southern Cross was in constant touch with the world by radio. Radio amateurs in America and Australia were able to keep a complete log of the trip and still prize it among their most treasured possessions.

Lyon, too, had proved the accuracy of air navigation with modern equipment. He had installed an earth inductor compass, three magnetic compasses, an aperiodic compass, a radio direction finder, several types of sextants, a speed and drift meter, pelorous drift indicator, smoke bombs for day use and water lights to gauge drift at night.

He accurately pin-pointed the track throughout the trip and was rarely more than a few miles off course except on the last leg when storms swept the aircraft miles off its course.

Australian Captain P. G. Taylor, co-pilot and navigator with Kingsford-Smith on many of his later flights, including the historic crossing of the Tasman Sea, in May, 1935 (when he climbed out under the main plane to repair a leaking oil pipe in mid-air) summed up the conquest of the Pacific in Sydney recently:

"The 1928 Pacific flight was a complete vindication of Kingsford-Smith and Ulm's long struggle to obtain an aircraft to make the flight. They proved that an aircraft could fly the Pacific. It was the beginning of the regular air service now operating."

In this rapidly moving world we are inclined at times to take too much for granted and give little regard to the pioneers who made our progress and pleasures possible.

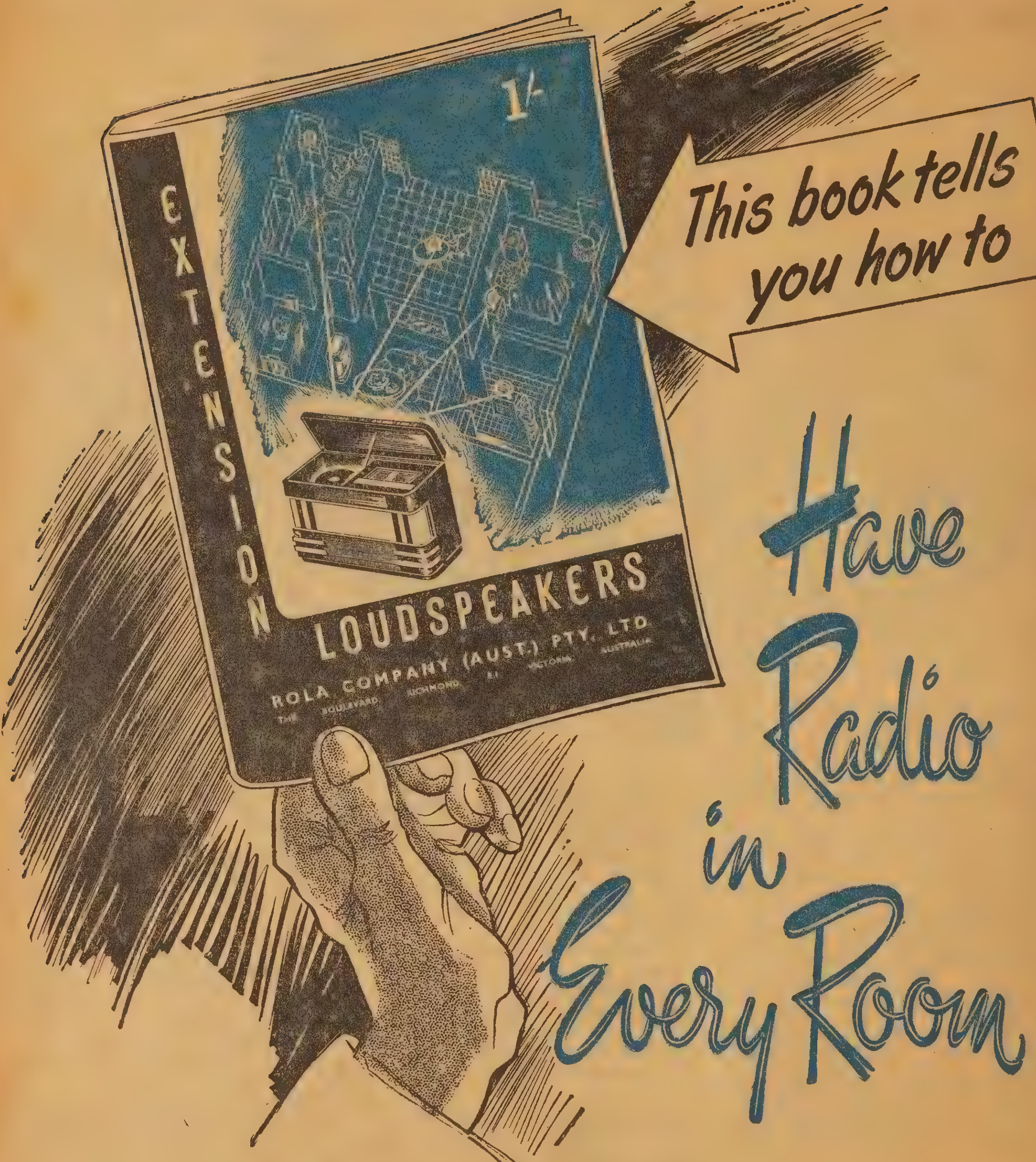
The conquest of the Pacific 25 years ago was an achievement as successful and thrilling as Ed. Hillary's recent conquest of Everest. James Warner will long be remembered for his clear cut morse and as a man who set out to prove the value of radio to international aviation. Like his captain he, too, succeeded.

A NEW WAY TO KILL WEEDS

Recently demonstrated at the Electrical Research Association's agricultural field station at Shinfield, near Reading, Berkshire, was an experimental model of an electrical plant "singler" which was designed for use in sugar beet fields, and which can also be used to single out any plants or weeds.

This new "singler" which is carried by the operator on his back, can be worked either by battery or direct from electrical mains. When "switched-on" the set emits a low amperage-high voltage current through the poker-like rod. The operator by touching a plant with the rod while the set is working kills its roots and ends its growth.

The operator wears the earthing device attached to his boot, and when making contact with the earth with the rod, the current completes its circuit. The Electrical Research Association field station at Shinfield is continually engaged in research into the application of electricity in agriculture and horticulture. This picture shows the experimental model of the plant "singler" being demonstrated. The earthing attachment can be seen on the operator's right shoe.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NEW EFFORT TO USE SUN'S RAYS

Under the joint authority of the National Scientific Research Centre, and the Committee for Scientific Activity for National Defence, France is at present making large scale experiments in the harnessing of solar energy, by means of optical apparatus.

FOR the purpose, a large open-air laboratory has been set up within the precincts of the Mont-Louis fortress in the Western Pyrenees.

The experiments, carried out by a well-known expert, M. Felix Trombe, promise to make the sun—for industrialists as well as for scholars — a serious rival of the electric arc. Their aim is to realise in practice an age-long dream.

According to tradition, Archimedes, in Syracuse harbor, set fire to the Roman fleet by means of mirrors concentrating the sun's rays on the enemy ships.

EARLY EXPERIMENTS

More authentic and practical experiments were performed in the 18th century by the French naturalist Buffon: his apparatus is still in existence in the Conservatoire des Arts et Metiers in Paris. It is a simple dial affair, in which are set a large number of small adjustable mirrors. These enable the reflected rays to be concentrated on the target.

Today optical technique puts at our disposal true concave mirrors capable of concentrating the sun's rays much more powerfully. Even the mere reflector of a car headlight, turned toward the sun, produces at the point where the lamp was a source of heat capable of setting fire to combustible matter.

What is more, there is no wastage of heat obtained by such means, for no crucible or other receptacle need be in contact with the matter to be fired. A piece of steel wrapped in a transparent glass or cellophane envelope can be melted by the rays without material contact.

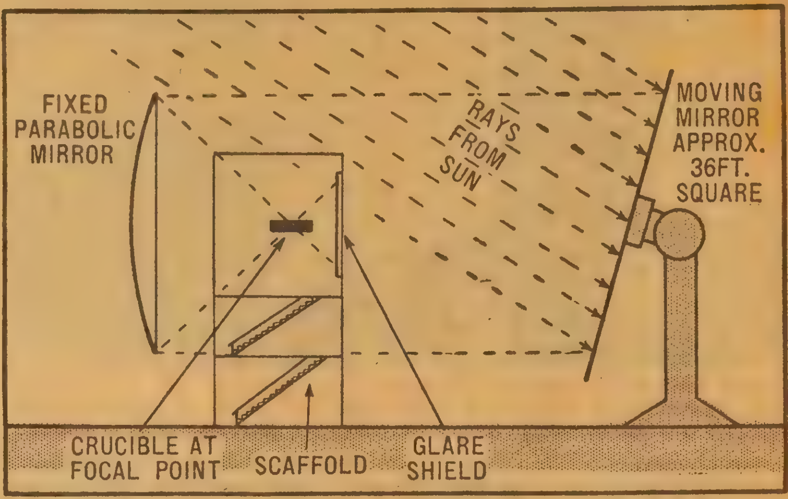
Harnessing solar calories in order to produce mechanical and then electrical energy is indeed a fascinating project. As early as 1914 Schumann, at Mehadi, near Cairo, installed a steam engine of about fifty horsepower worked by a "solar boiler". It used a tube of blackened metal in which water circulated along a line of enormous cylindro-parabolic mirrors.

A simple mechanism enabled the long line of mirrors to be tipped so as to follow the movement of the sun.

OIL BOILER

A "solar oil burner" has also been used with good results. A pump injects water into a mass of oil raised to a temperature of 300 degrees by the solar rays. A violent emulsion is produced, the high temperature steam being taken off to turn a machine, while the oil drops back into the boiler.

In a rather different field, solar rays may be used to produce cold! The paradox is only a surface one, however. We are all familiar now with "engineless refrigerators" using the principle of evaporation discovered by Lord Kelvin and worked by lighting a gas or oil flame.



In the new French equipment, a huge flat mirror surface re-directs the sun's rays onto a fixed parabolic mirror—actually many small mirrors attached to a parabolic shaped frame. The rays focus on to a movable frame holding a crucible. Personnel have to wear welders' goggles to protect their eyes from glare.

It suffices to replace this flame by a concave mirror a few decimetres in diameter to obtain an identical result.

What is probably the most powerful of these "helio-refrigerating" plants is to be found at Tashkent, in Russian Turkestan.

by Pierre Devaux

It consists of a hollow paraboloid, in concrete, 80 metres high, lined with small silvered mirrors which reflect the rays on to an ammonia refrigerating chamber—an example of the gigantic proportions this type of equipment can attain.

At the present time "solar kitchen ovens" are being manufactured consisting of a reflecting "parabole", one metre in diameter, in the centre of which one can . . . cook. A chop grills in a few minutes and a litre of water boils in less than a quarter of an hour.

The scientists of Mont-Louis are using as firing mirrors former French anti-aircraft projectors 1.5 metres in diameter or German two-metre projectors.

The rays coming from the sun are turned back toward concave mirror-ovens by a large-dimensional rotating plane mirror, thus producing a "fixed sun". The concave mirror is installed in a building in an alcove so that to turn off the oven one has only to draw a curtain.

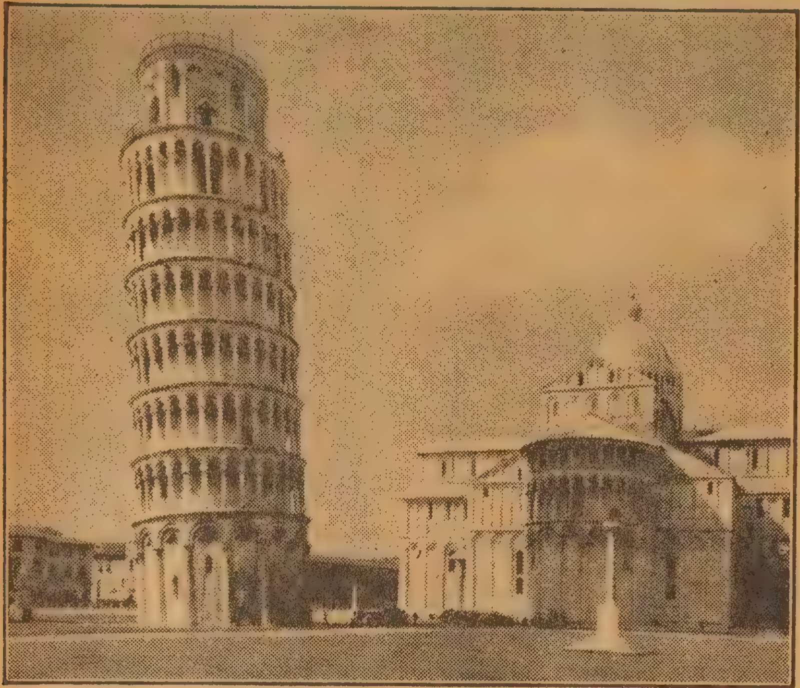
The temperature in the heat chamber of these scientific solar ovens exceeds 3000 degrees; it is therefore comparable to that of an electric arc.

INTENSE HEAT

Non-conducting crucibles are used, conserving the heat like the familiar hay-box, and also "window-crucibles" in which the rays are concentrated, so that steel can easily be melted or even platinum and many of the precious stones that are reputed non-fusible.

These operations take place in natural conditions without cumbersome electric generators and, if necessary, under suitable atmospheric conditions—all of which seems to promise a highly successful future.

BELL LABS' "AUDREY" (automatic digit recogniser) translates spoken numbers directly into selective switching operations. Audrey now responds dependably only to clearly enunciated syllables, but may some day do away entirely with dials and even operators—you may literally "call" a number merely by speaking into your telephone.



Though standing 16½ feet out of perpendicular, the famous Leaning Tower of Pisa does not in effect "defy the laws of gravity". The centre of gravity is still well within the base area and its balance has not been disturbed either by war or earthquake.

A SUBJECT OF MUCH GRAVITY

This month we are to discuss what at first may appear to be a very dry subject but what is really a most interesting one, for it concerns the stability of every structure animate or inanimate which is on the earth. We are to consider the "Centre of Gravity".

PEOPLE can have various ideas of the meaning of "Centre of Gravity". For instance, a conference to decide peace or war could be a centre of gravity, or even a parliamentary session could be classified as one.

We speak of a beautiful film star or a noted person as being the centre of gravity at a social gathering, meaning, of course, that people gravitate toward them or gather around them.

In fact, as far as we men are concerned, there are plenty of centres of gravity around any town. Nice, aren't they. On a hot day they always look so lovely and cool. Plenty of body. Low collars. Bit expensive, though. A shilling for a middy of beer. Fancy, but I am getting off our subject!

Let's get back.

WHAT TERM MEANS

Just before we do, how about an undertaker's parlor being the ultra as a "centre of gravity"?

Now, none of the definitions heretofore mentioned will serve our purpose. The real definition can be simply stated as "the point of a body in which the whole weight of the body appears condensed". It is the centre of weight or the point at which the whole weight of the body pulls down.

Don't be alarmed at this and turn to another article just yet. None of them is as good as this one is going to be. All will yet be clear.

by *Calvin Walters*

The centre of gravity explains many things. It explains why double-decker buses don't fall over. Why there is no standing on the top deck. How a tight-rope walker walks. Why a building stands upright. How people walk on stilts. Why ships stay upright. How a submarine floats, and, last but not least among lots of other things, how we ourselves stand up.

The last item reminds me of a good one I heard about a sunken-chested, round-shouldered, thin-legged, hollow-faced, bleary-eyed, gasping young man who went to a doctor for an examination. He said to the doc. "How do I stand, doc?" and the doctor said, "Hanged if I know; it's a darned miracle".

Most of us use our centre of gravity quite unconsciously, and so do animals. Engineers, however must find by calculation the centre of gravity of structures they build.

A simple example of finding the centre of gravity is when we take a stick and try to balance it on our finger. We find the approximate centre and by moving the finger a little to one side or the other we manage to find a point at which the stick balances like a see-saw. This is the centre of gravity. A see-saw indeed, is balanced on the same principle.

THE SEE-SAW

With a see-saw, the centre of gravity is often upset by the weights of the children on one end being greater than those at the other end. Children unconsciously adjust this by the heavier ones moving closer to the centre and thus restoring the centre of gravity. And when one party suddenly jumps off his end the position is one of gravity indeed for the party at the other end is let down with a thud.

Yes, somewhere in every structure there is situated this centre of gravity. It is this point which is always tending to fall to the lowest point in the direction of the centre of the earth. If a line is drawn from the centre of gravity to the centre of the earth it is called the line of direction. The part of a structure which supports it is called its base.

Thus, our feet are our base. The width between the wheels of a vehicle is its base. The area enclosed by the four feet of an animal is its base, and so on.

Any object will remain stable while the line of direction remains within its base. A glance at figure one overleaf will make this clear. I hope. The line AB is the line of direction. C is centre of gravity. The line DE is the base.

Now figure 1b shows what happens when the line of direction runs outside the base. The centre of gravity is shifted and the object becomes unbalanced and falls over.

Now, to get back to our double-decker bus. It looks top-heavy, but it isn't. The base is as wide as possible. To gain more width, the wheels are flush with the sides. The engine is heavy and placed low down in the chassis. The upper deck is of much lighter construction than the lower. Thus, the centre of gravity is low down in the body. When the lower deck is filled with passengers the centre of gravity is well down in the body, say, at a level with the seats, between the aisle.

If you imagine a line drawn from the aisle straight down to the ground between the wheels this will be the line of direction. Now it is easily seen that to tilt the bus sideways so that this line falls outside the wheel base would require a very big tilt indeed and there is not much danger of this.

The position is a bit different if the lower deck was empty and the top deck full. The centre of gravity would be raised say to the floor of the top deck and a line of direction drawn from there to the ground would show that the bus would require less of a tilt than before to tip it over.

NO STANDING!

That is why standing is not allowed on the top deck. Also why the lower deck is always filled first. Standing passengers on the top deck raise the centre of gravity too high.

The loaders of vehicles such as timber wagons and vehicles carrying wool bales sometimes overdo it and put too high a load on the wagon. The centre of gravity is thus raised too high. The vehicle encounters a sloping road and the line of direction from the centre of gravity falls outside the base and over she goes.

Human beings have a very narrow base on which to stand. It is the space occupied by our feet. Thus the bigger the feet the better the standing ability. Our centre of gravity is rather high up in our bodies which can be proved by standing rigid and getting someone to give you a push. One does not have to move very far before one begins to fall over. The line of direction from our centre of gravity moves to outside our feet base and we go over.

In such circumstances, we automatically restore our balance by increasing the width of our base by putting one foot forward if we are falling forward or backward if we are falling backward. The line of direction again falls within the base and we remain erect. It is this constant unconscious effort to keep the line of direction within the area occupied by our feet that makes standing very tiring. When standing erect, we continually sway slightly in various directions and our muscles and tendons are moving all the time to keep our bodies so that the line of direction remains within our feet base.

STANDING "EASY"

When standing at ease with legs apart our base is considerably increased in a sideways direction and, as the wider the base so the easier to stand, the tension of standing is minimised.

This widening of the base to increase stability is well illustrated with a tall floor standard lamp. If the base is small and the lamp shade is wide and heavy the centre of gravity is high and the lamp will fall over. Widening the base even with a light piece of wood increases the stability because the stand will have to lean over to a much greater extent before the line of direction falls outside the base.

Double decker buses may appear to lean perilously on curves but, as this diagram shows, their weight is still concentrated well within the wheel track.

Tight rope walkers maintain their balance by means of a long pole. The base on which they stand is only the width of the rope. The pole is carried at right angles to the rope and the walker glues his eyes to a point somewhat in front of his feet. He can thus detect the slightest deviation from his position of balance and counteract it by moving the pole to restore the centre of gravity and keep the line of direction through his feet.

It is only necessary to balance from right or left across the rope because along the length of the rope there is the same length of base as there would be while standing on the ground.

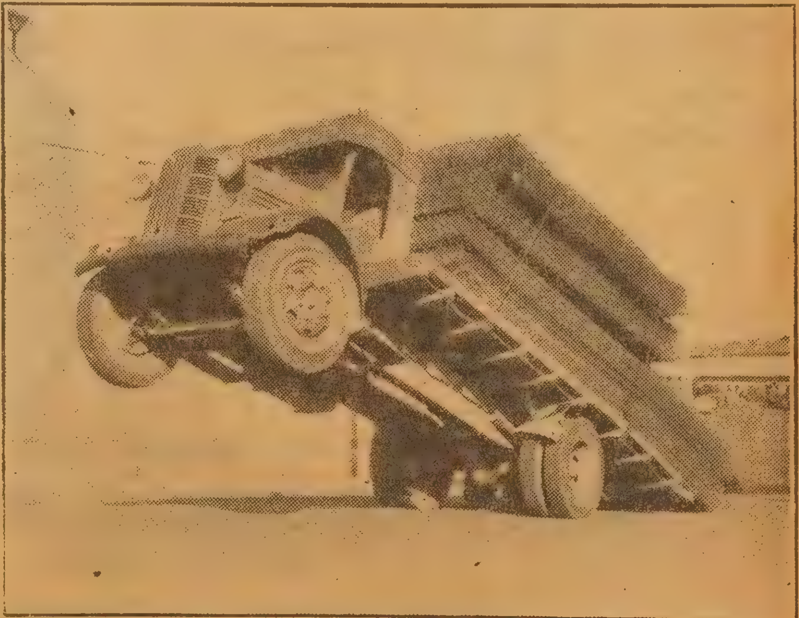
A quadruped can stand up without effort because his base is very wide, being the area encompassed by his feet. He would have to lean over a long way before his line of direction fell outside his feet.

The art of running, whether for a sport or away to fight another day, depends on leaning forward enough to get the centre of gravity just over one's toes or a little in front of them so that there is always a tendency to fall forward but not enough to fall over. The runner is always chasing himself, as it were. One can't run easily by standing too erect or leaning too far forward.

In animals, the centre of gravity seems to depend on the size. In large animals, like the elephant and the lion, the centre of gravity is centred over the forelegs and the body tapers off to the tail. It is wonderful how nature adjusts things in this way. Large animals usually have short bodies. If an elephant had as long a body in proportion as a dachshund dog it would sag in the middle because of the unsupported weight. But small animals like the said dachshund, can have a long body because of its light weight.

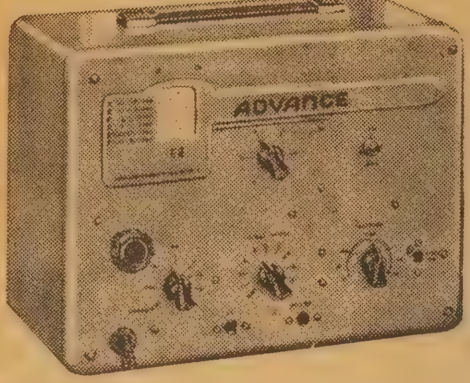
MAY TIP FORWARD?

The elephant does not taper off to the rear as much as a lion or bison because he has a heavy trunk in front. This balances a lot of the weight behind and brings the centre of gravity forward. On the other hand a kangaroo is like an elephant in reverse. The weight is concentrated over the hind legs and the powerful tail used in jumping is like the elephant's trunk, except that it balances the weight in front and



Somebody stacked the load on this lorry too far back. The combined effect of an up-grade and perhaps too rapid acceleration carried the effective centre of gravity behind the rear wheels with this rather unnerving result.

Advance SIGNAL GENERATORS



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the front of the kangaroo tapers off like the rear of the elephant.

There are many toys which use the centre of gravity principle as their attractive feature. Small wooden dolls are weighted in a hemispherical base. When laid over and held down then released they fly upright again because the centre of gravity is low down in the base. This is a case illustrating the differences between stable and unstable equilibrium.

When a body is in such a position that, on its position being slightly altered, gravity tends to bring it back into its former position, it is said to be in a state of stable equilibrium.

When it is in such a position that on being slightly shifted, gravity tends to draw it still more out of its position, it is said to be in a state of unstable equilibrium. The toys mentioned above are in unstable equilibrium when laying down and stable equilibrium standing up.

NOT MR. WALTERS!

This property is made use of in the game of bowls. Now I play bowls, so no one must say it is only a game for whisky-drinking old men if I am not to be insulted. I'm not old at all. It is a scientific adaptation of various physical laws.

One goes down to the greens and there he finds Mac and Jack and Allan and Joe and Jim probably around the centre of gravity in the clubhouse.

Stan is there, too, a keen bowler with badges all around his hatband to prove it. None of these fellows is old either, but they all carry a yellow rag to wave at the bowls as they go up the green. The bowls are composition weighing about 3½lb and about 5in in diameter.

Now these bowls are not true spheres. If they were they would roll up the green in a straight line and, as the idea is to get closer to the little white ball than the other fellow, this would be more difficult with a spherical bowl than it is with the regular style bowl, especially if you are one of the last to play. The game would be merely like a game of skittles.

A ROUND OF BOWLS

To make the game more interesting and easier bowls are made oval so that the centre of gravity is on one side and not dead in the centre like a true sphere.

The game is played by standing on a mat and delivering the bowl nice and smoothly (like I do—not thrown down like some others do) on to the green, rolling it along on its greater diameter with the bulging side of the bowl facing, let us say, the left.

As the bowl will take a curved course it is not aimed directly at the target, but somewhat to the right.

Now nature does its best to have things run in a straight line, and the direction of motion cannot be changed from the straight line without the application of some force.

As the motion imparted by the bowl tends to keep the centre of gravity up, it can be likened to the action of a gyroscope. However, the centre of gravity to one side of the bowl is always tending to pull it down until the line of direction falls within its base, where it will be stable.

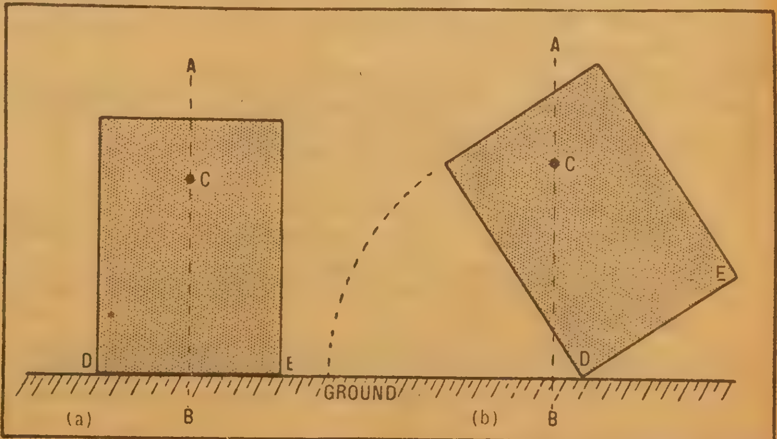
As the bowl slows down, the force which keeps it on its edge becomes less and less, and gravity begins to pull the centre of gravity of the bowl further down. In doing so it rolls on a circumference which is rapidly decreasing (consider the difference between the circumference of the earth at the equator and near the poles to get an enlarged clear picture of the above).

This decrease in diameter and speed screws the bowl around until it will move in almost a half-circle before it comes to rest. If there is nothing to prevent it, such as blades of grass, &c., it will fall over on to its bulging side, where it is in stable equilibrium.

Sometimes, if it happens to rest on its major diameter, a slight movement will make it fall over, much to the chagrin of the opposing side if it falls toward the target.

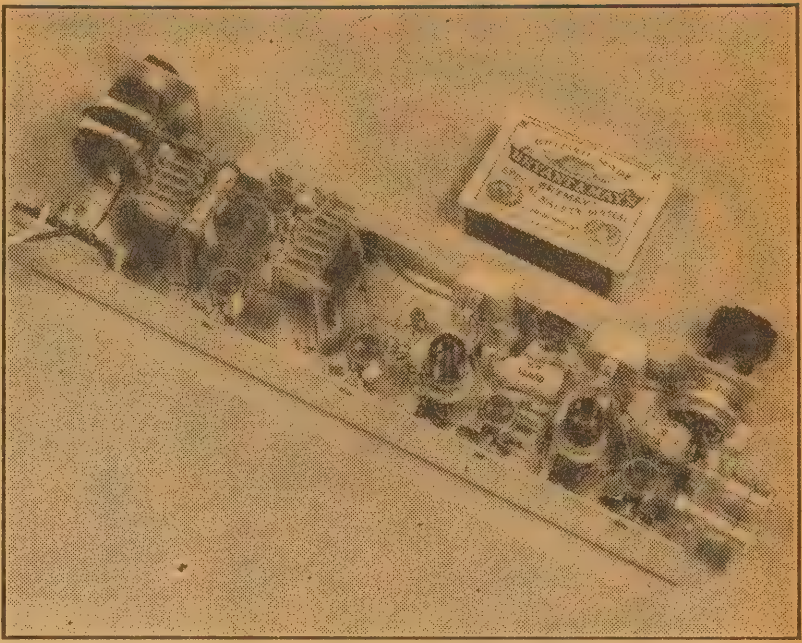
Thus it is that bowls becomes a game of science, for the forces involved, together with the skill of the player, enable the course of the bowl to be plotted to circle around an opposing bowl and thus get nearer the target than would otherwise be possible.

Golf balls are accurately made so that the centre of gravity falls dead in the centre of sphere. Some trick golf balls are made with the centre of gravity away from the centre so that, if given to an unsuspecting player, they take an erratic course up the fairway or when putted on the green.



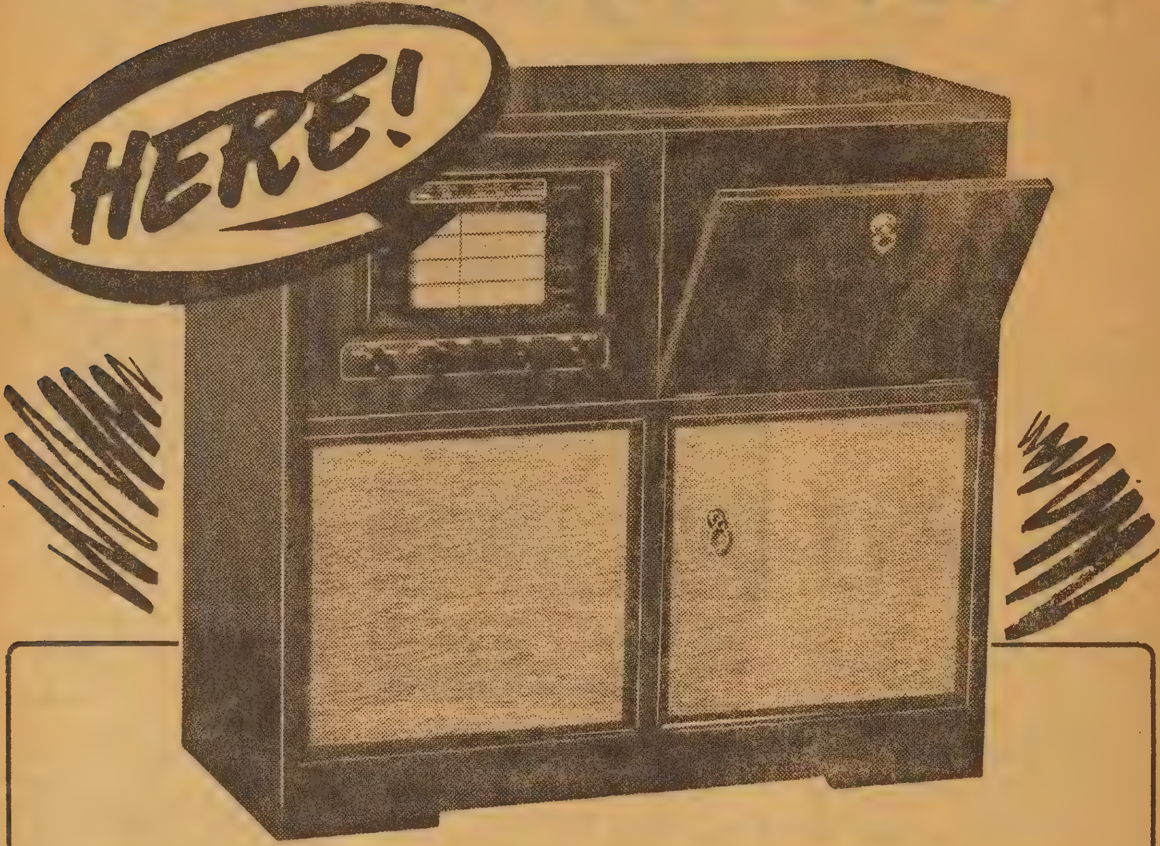
Illustrating the principles of stability.

GERMANIUM TRIODE RECEIVER



Once mass production has reduced cost of transistors to a reasonable figure, home constructors may well find themselves building miniature receivers like the one pictured above. The elimination of the normal filament, together with reduced high tension requirements greatly simplifies the battery requirements.

YOUR NAME GOES



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Technical Review

LUMINESCENT CAPACITORS MAY DISPLACE C.R. TUBES

Direct transformation of electrical energy into light through electroluminescence is becoming increasingly important in the lighting field, but even more important uses may lie ahead in the field of electronics.

ELECTROLUMINESCENCE is the property of certain materials that causes them to emit light when placed in a fluctuating electric field.

It may be produced by a device comprising a film of phosphor dispersed in the dielectric between two conducting plates. Such a luminous capacitor is shown in Fig. 1.

One plate is of electrically-conducting glass while the other is formed by coating the dielectric with vaporised aluminium.

Another type of luminous capacitor consists of a pair of enamelled copper wires in close contact wound side by side on a glass tube. Phosphor suspended in oil is brushed over the wires and luminescence produced by an alternating potential of about 200 volts.

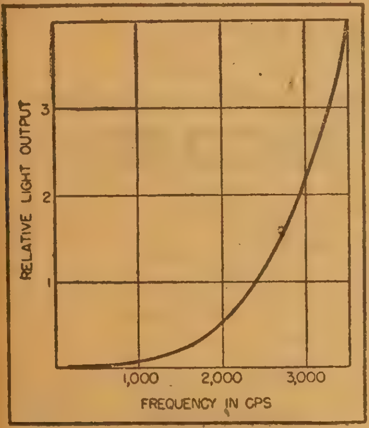

FIGURE 3. Relative light output versus frequency at constant voltage.

Present applications include illuminated clock faces, instrument dials, dashboard and cockpit lights.

These lamps are characterised by instantaneous operation and smooth dimming to extinction through control of applied alternating potential.

Intensity of emitted light depends upon thickness, resistivity and dielectric constant of the phosphor and the frequency and magnitude of the applied potential.

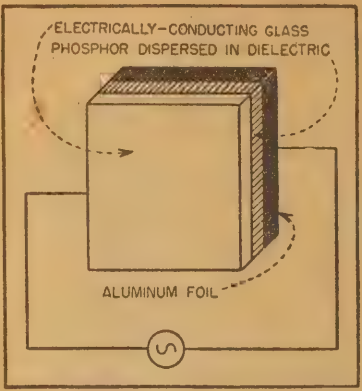
ELECTRICALLY-CONDUCTING GLASS
PHOSPHOR DISPERSED IN DIELECTRIC
ALUMINUM FOIL

FIGURE 1. Electroluminescent screen resembles ordinary capacitor.

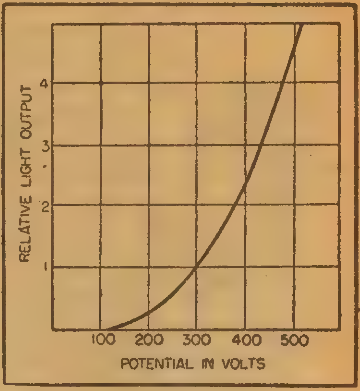

FIGURE 2. Relative light output versus voltage at constant frequency.

Figure 2 shows the variation in light output with voltage for a 60-cps alternating potential. Figure 3 shows the relation between light output and frequency; the potential was held constant at 100 volts.

A given amount of light is emitted each time the luminous capacitor is charged to a given voltage. The more times per second this occurs the greater will be the amount of light emitted.

The luminous capacitor is being investigated as a possible substitute for cathode-ray tubes.

Although no perceptible color change occurs as a luminous capacitor is dimmed, a definite color change has been observed with variable frequency operation.

A lamp that luminesced yellow-green at 60-cps can be made to glow pale-blue-green at 3000-cps. This property has suggested several additional uses for the luminous capacitor.—J.M.C.

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S. Roberts, Field Strength and Temperature Studies of Electroluminescence Powders in Dielectric Media, Jour Optical Soc. of Amer., p. 850, Nov., 1952.

FURTHER PROGRESS ON TV TAPE

HAVING improved picture quality "more than 20 fold" since the first sight and sound magnetic tape recording system demonstration a year ago, the electronics division of Bing Crosby Enterprises, as part of an "interim report" demonstrated recently to the Press its VTR (Video Tape Recorder) with showing of live telecasts and motion pictures taken off the air.

The demonstration was clear and sharp, except for occasional "ghost" images and an overriding diagonal weave.

Reaction to the showing was varied. Press in general agreed with Mr. Healey that quality was "more than 20 fold" better than the first showing. Some compared it favorably with quick kinescopes.

Work on the VTR system is now more than 80 pc completed and Mr. Healey expects that production models will be ready for the trade late this year or in early 1954. It is planned that Ampex Electric Corp., Redwood City, Calif., will handle production. The VTR equipment, including recorder and playback, will cost around 50,000 dollars, but it was pointed out that savings in time and tape will more than compensate.

Cost of the magnetic tape, made by Minnesota Mining and Manufacturing Co., is said to be approximately one-fourth that of motion picture film Although one-inch wide tape was utilised for the demonstration, a one-half inch wide tape is planned for final usage.

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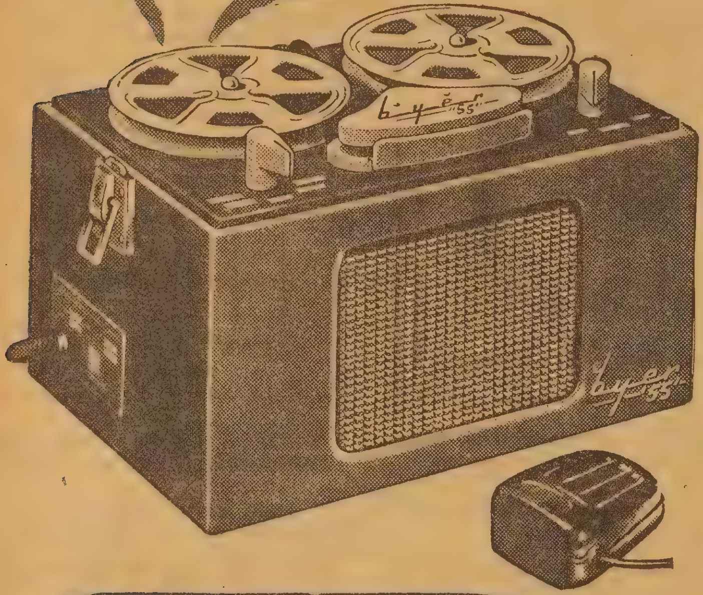

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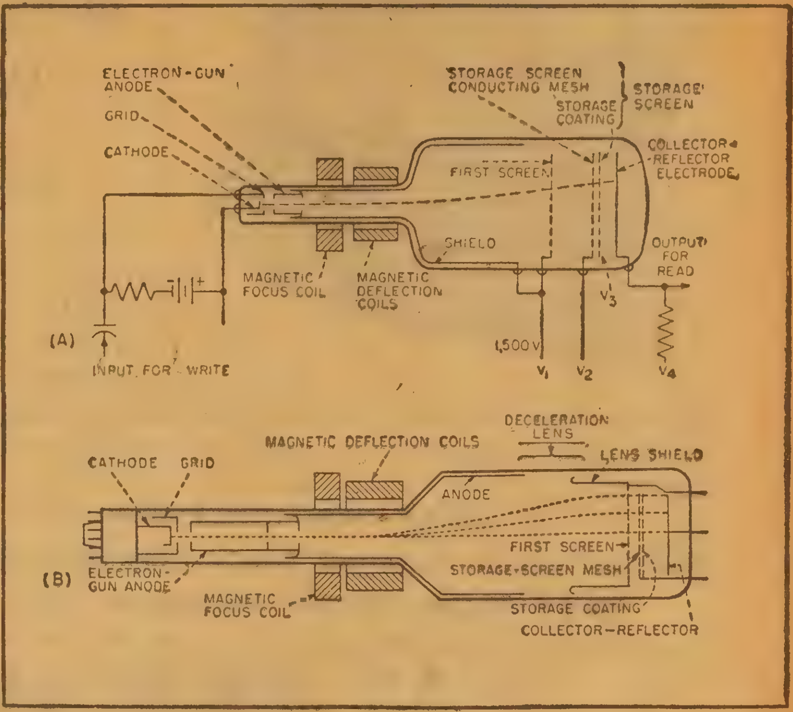
STORAGE TYPE PICTURE TUBE AIDS INDUSTRY AND TV

An interesting phase of development in overseas television engineering is that of image storage type tubes. These have many applications in the industrial, navigation and entertainment fields and now appear to be reaching the stage where most of the early problems have been ironed out.


ELECTRON-GUN ANODE
GRID
CATHODE
STORAGE SCREEN CONDUCTING MESH
STORAGE COATING
STORAGE SCREEN
COLLECTOR-REFLECTOR ELECTRODE
FIRST SCREEN
SHIELD
OUTPUT FOR READ
MAGNETIC FOCUS COIL
MAGNETIC DEFLECTION COILS
(A)
INPUT FOR WRITE
1,500 V
V1
V2
V3
V4
DECELERATION LENS
MAGNETIC DEFLECTION COILS
LENS SHIELD
CATHODE
GRID
ANODE
FIRST SCREEN
STORAGE-SCREEN MESH
(B)
ELECTRON-GUN ANODE
MAGNETIC FOCUS COIL
STORAGE COATING
COLLECTOR—REFLECTOR

An early type of storage tube is shown at (A) and a later version at (B). Main improvement is the use of an electron lens to allow the electron stream to strike the mesh at right angles. The stored image is still usable after 27,000 scannings.

IN industrial applications there has always been a need for some method of storing many of the images which appear on the screen of a cathode ray tube. Where the observed phenomena is recurring at a constant rate it is a relatively simple matter to photograph the screen, though the subsequent processing is something of an inconvenience.

The real problem occurs when it is desired to observe—and record—transient phenomena which produce but one trace on the screen. Normally a single trace occupies such a short period of time that it would be useless trying to observe it and difficult to photograph it unless some form of image storage was used.

Another problem is the observation of phenomena which occurs so slowly that the persistence of vision or storage time of the screen is too short to allow a complete picture to be built up.

LONG PERSISTENCE

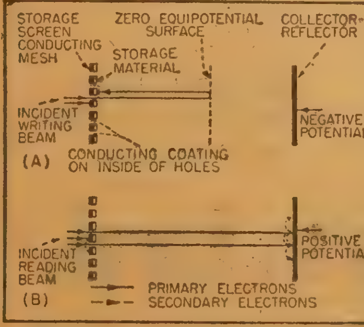
Until recently the only method of image storage available has been the long persistence screen used in certain types of cathode ray tubes. These will store the image for several seconds and permit the pattern to be observed and even photographed in favorable circumstances. However, the image fades fairly rapidly and presents a difficulty where it is desired to compare it with previous records.

Similar problems occur in the use of navigational aids, and the ability to store for immediate or future reference any pattern presented on a radar ppi screen is a definite advantage.

In the field of television the requirement has not been so obvious but, when it is provided, a number of interesting possibilities present themselves.

The present approach to the problem is to provide the storage facility in the form of electrostatic charges which are retained on a special mesh screen within a tube similar in general conception to television camera tube.

The accompanying diagram (Fig. 1) will give some idea of the general layout, the drawing at (B) showing the design of one of the latest type tubes. It will be seen that the tube consists of the usual cathode, grid, and electron gun, plus deflection and focusing coils. However, in place of the usual screen there is a very fine mesh screen through which the electron beam passes, the mesh of the screen being so fine that the cross sectional area of the electron beam covers approximately six openings in the mesh.


STORAGE SCREEN CONDUCTING MESH
ZERO EQUIPOTENTIAL SURFACE
COLLECTOR-REFLECTOR
STORAGE MATERIAL
INCIDENT WRITING BEAM
NEGATIVE POTENTIAL
(A)
CONDUCTING COATING ON INSIDE OF HOLES
POSITIVE POTENTIAL
INCIDENT READING BEAM
(B)
PRIMARY ELECTRONS
SECONDARY ELECTRONS

Showing the path of the electrons for (A) recording and (B) reading. Actual image appears on a second tube.

SPECIAL ELECTRODE

Beyond the mesh there is another electrode called a collector-reflector, the actual function of this being determined by the voltage applied to it. To store an image on the screen this electrode is operated as a reflector by the application of a negative voltage. Under these conditions the electrons pass through the mesh and are then reflected from the negatively charged reflector, eventually striking the elements of storage material on the face of the mesh.

The electrons strike the storage elements with sufficient velocity to cause secondary emission from each element, thereby giving it a positive charge. In this way a picture is built up on the mesh in the form of electrostatic charges on each element. Because of the construction of the mesh each element is effectively insulated from its neighbor and so will hold its charge for periods up to a week if undisturbed.

In order to "read" the stored image the final electrode is operated as a collector, by making it positive, and the electrons from the gun now pass through the mesh on their way to it.

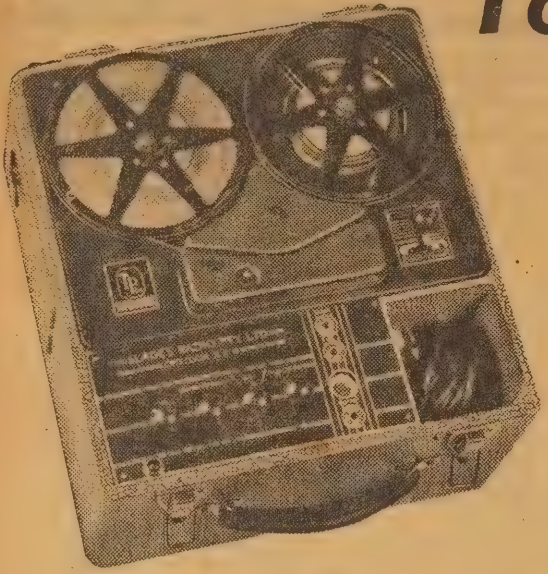
By making the mesh, as a whole, sufficiently negative, those portions of it which were not given a positive charge will repel the electrons, whereas those parts with a positive charge will allow them to pass. A load resistor in the collector circuit allows a voltage to be developed which is proportional to the number of electrons and which can be applied to the control grid of a viewing tube.

IMAGE REMAINS

In use, the tube would have its deflecting coils and control grid connected in parallel with the equivalent circuits of the original viewing tube if recording or the reproducing tube if "playing back".

Although the image will remain virtually intact for several days if undisturbed, it deteriorates much more rapidly when being scanned. Even so, it is capable of reproducing the image for from 10 to 15 minutes continuously or for the same time spread over shorter viewing periods.

(Continued on Page 99)



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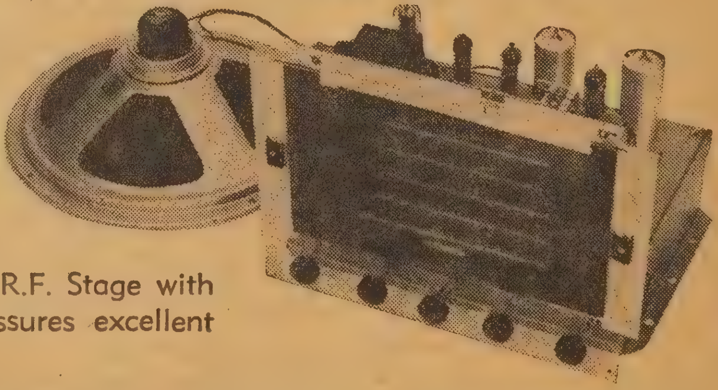

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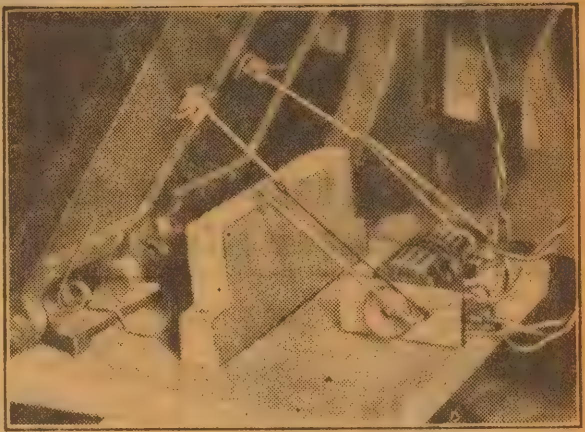
FITTING CONTACT MICROPHONES TO A REED ORGAN

There is always a lot of interest in attempts to improve reed organs or harmoniums by the aid of electronics. This article, re-printed from "Radio-Electronics" for April 1953, describes a very simple method of improving a reed organ by the addition of an amplifier system.



Details of the swell control mounted behind the pedals. The shape of the wire bow can be clearly seen on the control nearest the camera. The vertical block is the pedal stop.

ATTEMPTS to amplify organ sounds by means of a conventional microphone and amplifier usually presents a number of problems. One is the tendency to acoustic feedback if the speakers are placed where the organist can hear them properly. The other is the difficulty, due to hum pickup, of providing swell facilities in the individual microphone circuits.

In this installation the two problems are solved by the use of contact microphones to minimise acoustic pickup and feedback, and by making them low impedance types to eliminate hum pickup and allow the use of simple control circuits.

A further advantage is that the contact microphones may be made quite cheaply from headphones salvaged from disposals stocks.

MOVING COIL TYPES

Those used in the original were low impedance (nominally 50 ohm) moving coil types which have been readily available through disposals stores. To convert to a contact microphone, the cover should first be removed and half inch hole drilled in the centre of it. A similar size hole is also cut in the centre of the oiled silk moisture seal that covers the diaphragm.

Next a number of 3-8in cork discs are cut from gasket material, the exact number depending on the thickness but being sufficient to form a stack about ¾in high. These are cemented together and then cemented to the centre of the diaphragm. See fig. 1.

If a card punch or belt punch is available having the necessary diameter, this will assist in cutting the discs. If not available, they may be cut by hand and trimmed up when the stack is glued and dry.

When the cork stack is securely fastened to the diaphragm the cap may be replaced and four small rubber blocks cemented to the face of it. These are cut from rubber erasers and are about 3-8in square and ¼in thick. The exact thickness should be adjusted so that the cork stack just rests firmly against any flat surface on which the rubber pads are placed.

The microphone is clamped to the sounding board by means of a wooden block and clamping arm, as shown in fig. 2. Another rubber block between the clamping arm and the body of the microphone ensures that the vibrations from the sounding board will reach the diaphragm only through the cork pile.

VOLUME CONTROLS

The original organ had two manuals and, since it was desired to control each separately, a microphone was attached to the reed chest of each, serving as a sounding board. The two outputs were each taken to a separate volume control and then fed to a simple mixer circuit preceding the main amplifier.

The volume controls are 175 ohm, heavy duty, wire wound potentiometers, again from disposals stocks but which should also be available as a regular item from manufacturers of such items. The exact value is not particularly critical. Less robust types are not recommended, as they are hardly likely to stand up to the fairly constant use they will be given.

Having provided controls, the next step is to provide some easy means for the organist to control them. In the original organ there were two foot pedals originally used to operate the bellows but which were no longer used since a power blower had been installed, and it was decided to make use of these.

The manner in which this was done is shown in the accompanying photograph. The two controls are mounted on a simple "U" shaped bracket located behind the pedals. To convert the pedal movement into the rotary movement required for the controls a simple, but effective, cord drive system was evolved. As can be seen from the photograph, a wire bow is attached to each pedal, the cord of the bow making a single turn around a small wheel on each control shaft. Thus, as the pedal is pressed, the control is caused to rotate.

The wheels are turned up from brass, or similar material, and should have a diameter at the bottom of the groove of ¾in. The overall diameter is 1 1-8in and the centre hole should be ¼in to suit the control shaft. The wheels should also be drilled and tapped to take a set screw, say 1-8in Whitworth grub screw, to hold it on the shaft. Finally drill a small hole from the groove to the outside to provide an anchor for the bowstring.

MIXER CIRCUIT

Figure 3 gives details of the pre-amplifier mixing circuits and any similar twin triode would be suitable. It is followed by a main amplifier consisting of a 6C5 feeding a 6SL7 phase inverter driving two 6V6's in push-pull. At least two speakers are desirable for systems of this kind, a diffuse source of sound helping to create the impression of a pipe organ, the sound of which the finished organ closely resembles.

It is also worthwhile experimenting to find the best position for the microphone. The centre of the back of the wind chest is probably the best location, as far as possible from the outside or internal supports so that it is free to vibrate. It may be desirable to try a location toward the treble end of the instrument to balance the output. The organist is best consulted about the final effect.

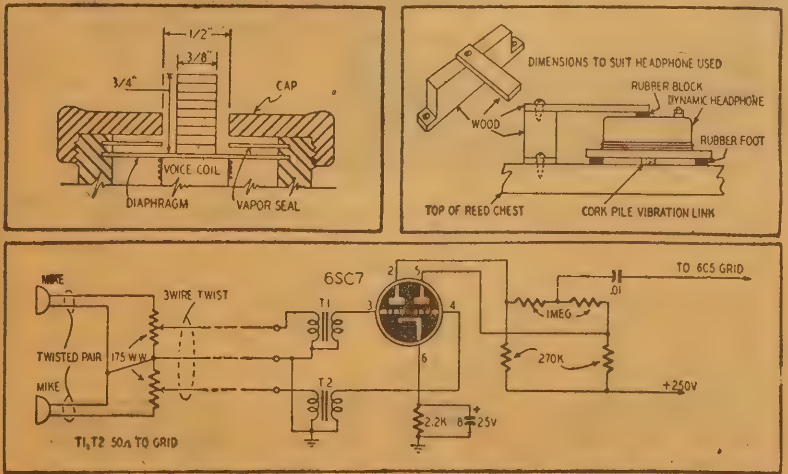


Fig. 1 (top left) shows details of the cork stack attached to the diaphragm and Fig. 2 (top right) shows how the completed microphone is attached to the sounding board. Fig. 3 is the volume control and mixing circuit. The low impedance eliminates hum problems.

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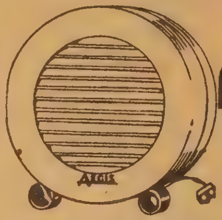

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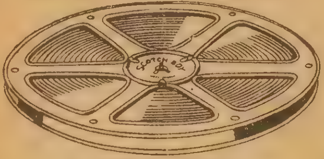

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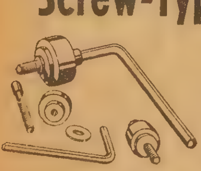

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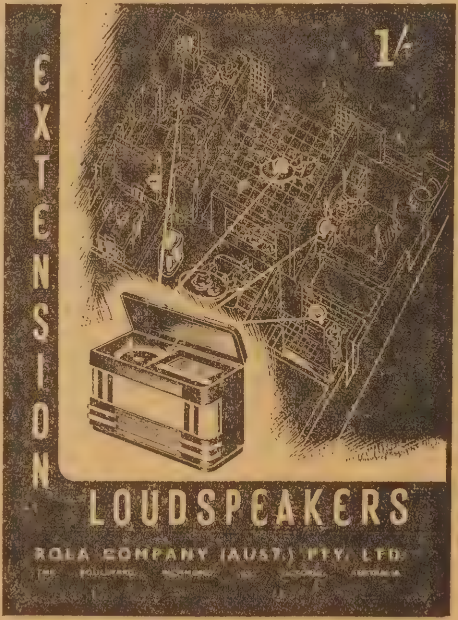

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NEWS AND VIEWS OF THE MONTH

Space station by 1963

A SPACE-STATION in operation for space-travel by 1963 and the first flight to the moon in 1977 are forecast by Professor Wernher von Braun, one of nazi Germany's top rocket scientists now working in the United States.

He made these prophecies in a lecture to scientists of West Germany's Space Research Society, read to a meeting here by Dr. F. Meyer-Cords, chairman of the North Rhine-Westphalian branch of the society.

Dr. Meyer-Cords said that he believes that United States scientists are already at work on building a space-station for use as a "firm base" for space travel, though he could give no details about it.

Scientists here, he continued, estimate that a space-station will course round the earth at a height of about 1062 miles beyond the earth's gravitational pull, in a manner rather similar to the way the earth courses round the sun.

The space-station will probably make one complete circle round the earth in about two hours.

The cost of such a station is estimated here at about £1340-million and it would have to be constantly supplied from the earth with all necessities of life, including air. This would be shipped in fluid form and the first shipment alone would weigh 24 tons.

Dr. Meyer-Cords said there are no serious outstanding technical difficulties to getting a crewless rocket to the moon. It is now merely a question of money.

The serious problems arise when it comes to trying to get man to fly through space.

Color TV

AUSTRALIA should begin television with color, the Lord Mayor of Sydney (Ald. P. D. Hills) said recently.

He was speaking at a civic reception after his Coronation trip to Britain and the United States.

Ald. Hills said Australia's delay in starting television would enable it to introduce a color system from the outset.

"If the American type of television ever comes to Australia, we will be disappointed," Ald. Hills said.

"The American program standard is not as high as the BBC's.

"Under commercial control in America, television seems an all-consuming monster.

"The Australian Government was wise to open an inquiry into television control."

Helicopter travel

BUTLER AIR TRANSPORT managing-director C. A. Butler has stated a British helicopter which could carry passengers between Sydney and Lithgow for about £2/11/- single fare should be flying in 1960.

He was commenting on proposals for a helicopter service to link Lithgow with Sydney.

While stressing his belief that helicopters have a commercial future, Mr. Butler said that that future was a long way off.

"Unless the service had a heavy subsidy, it would be commercially impossible," he said.

"A three-seat helicopter costs £30,000, and a 10-seater now only in the experimental stage in England, costs £100,000.

"The 1960 helicopter is to be a 20-seater.

"Figures at this stage can only be hypothetical, but we have studied this project and arrived at £2/11/- as the single fare from Sydney to Lithgow.

"Present train fare is £1/3/3."

Scientific party for Antarctic

THE Australian expedition to the Antarctic would leave Melbourne about January 9 next year, according to Mr. Casey.

Minister for External Affairs, he said the expedition would comprise 10 Australian scientists and technicians who would remain in the Antarctic for a year.

They would study meteorology, geology surveying, geophysics, and biology.

Mr. Casey said the expedition would be under the leadership of the director of the Antarctic division of the External Affairs Department, Mr. P. G. Law.

The Government had specially chartered the Danish motor ship Kista Dan to take the expedition to Antarctica.

The motor ship would call at Heard Island on the way to the Australian section of Antarctica.

Mr. Casey added, "She will put ashore the Australians who will man the Heard Island station during 1954

POPULAR SCIENCE QUIZ

Q. What is "algin"?

A. "Algin" is a chemical by-product of seaweed. It is being used to an increasing extent in the manufacture of paper, the usual form being sodium alginate. It forms a film on the surface of the paper and improves its ability to take ink.

The algins are also used for surface sizings, coatings and adhesives. It is a useful sizing for water-base coatings because the coating penetration can be controlled for any predetermined absorption.

Q. What is "carbonitriding"?

A. This is a form of metal case hardening which is beginning to supersede the method termed carburising. It is claimed to reduce industrial costs and to give a better surface wear resistance to such items as timing and crankshaft sprockets, steel transmission gears, bushings, steering-gear parts, &c.

The difference between this method and the older method of hardening is said to be caused by the nitrogen in the austenite of carbonitrided parts. This austenite is stable at a lower temperature than plain carbon austenite and transforms more slowly on cooling.

This means that the new method saves furnace fuel and reduces furnace maintenance by being done at lower temperatures. By permitting slower cooling, it avoids cracking or distortion and enables the core to be left soft if desired. Its ability to increase hardness, allows substitution of plain carbon steel for alloy steel in many applications.

Q. Locating oil is still a problem. Why is this?

A. A major problem which confronts all oil geologists is the lack of convincing information on the origin of oil. There are rather strong indications that this origin was rather similar to that of coal, that is, formed from organic matter over the centuries.

It is known that oil generally collects in a bed of loose sand between layers of rock. If the stratum in which the oil is trapped provides an upward bulge like a dome, the oil collects at the top of the layer in this dome. The associated gas, being lighter than the oil, collects above the oil. What gives the geologist much food for thought is the fact that below the oil there is usually a salt-water layer, having very much the same composition as sea-water.

Considering the extensive research and the amount of finance which has been devoted to the location of oil, very little has been acheived. Quite a definite amount of guesswork is still involved. An oil expert cannot be sure that oil is where he thinks it is until the drill brings it to light; and drilling can be expensive. According to an American Institute, the chances are one in eight in striking it rich in virgin field.

The most widely-used method of locating suspected oil fields employs the seismograph. Before the advent of the seismograph for this purpose, the gravity surveying method was used. This latter method was responsible for the location of some of the large oil fields along the Gulf coast of Louisiana and Texas. These days it is often used in a preliminary survey of a likely area.

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893-23	5000, 7000	2, 3.7, 8, 12.5	1	*40-15,000	5	SINGLE 6V6G, 6AQ5 ETC, TO VC	28/3
894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL	26/3
900-22	2500, 5000	2, 3.7, 8, 12.5, 15	1	*40-15,000	15	SINGLE 807, EL34 ETC, TO VC	57/6
896-9	8000, 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR ABI TO VC	62/6
897-9	8000, 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR ABI TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR ABI TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODES	57/6
871-9	10,000	2 or 8	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
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1682-H	220-230-240	285	60	6.3v-2A; 5v-2A	34/-
1636-3H	200-220-230-240	300	80	2 x 6.3v-2A; 5v-3A	42/9
1332-3H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
1356-3H	200-220-230-240	400	150	5v-3A; 2.5v-5A; 6.3v-4A	70/-
1380-3H	200-220-230-240	450	200	2 x 6.3v-2A; 5v-3A	95/-
1371-8	200-220-230-240	500-600-750 850-1000	300		150/-
1400-19	200-220-230-240	565-500-425	250	2 x 6.3v-3A; 2 x 2.5v-3A; 5v-3A	110/-
1643-23	200 or 230	—	—	6.3v TAP 5v-2A (500v insul)	17/6
1525-21	220-230-240	—	—	2.5v-10A (1000v insul)	47/6
1305-22	200-220-230-240	—	—	2.5v-10A (3000v insul)	75/-

FILTER CHOKES

Swinging Chokes Marked *

TYPE No.	INDUCTANCE-HYS		CURRENT mA	APPROX. D.C. RES.	MAX D.C. Working Vol.	PRICE
	MAX	FULL RATE DC				
957-23	20	15	60	320	500	16/6
973-9	30	20	80	370	500	33/6
3-21	30	20	80	370	500	25/9
1012-1A	35	20	120	430	1000	35/3
967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1311-1A	30	15	250	160	1000	59/6
*983-1A	25	20/5	30/300	90	1000	65/6
986-1A	15	10	300	60	1000	62/6

★ **NOTE: 20% SALES TAX TO BE ADDED TO ABOVE PRICE**

★ **MOUNTING DETAILS:**

H—3H: Horizontal mount with steel louvred cover. Sub-terminal panel.
—8: Open steel clamps. Terminal strip prim. & sec.
—19: Horizontal 6in x 5in cast cover. Sub-terminal panel.
26—23: Open steel brackets. Terminal strips.
6—10—9: Diecast case with solder terminals.
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together with their stores and equipment.

"She will then sail to the Antarctic continent and will cruise along the coasts of Princess Elizabeth Land and Macrobertson Land searching for a suitable site for the new mainland station.

"A survey of the coastline will be made at the same time."

TV in Italy

ITALIANS will tune in to their first regular television service on New Year's Day, 1954, five years after the first experiments in Turin.

Engineers have promised that about 20-million people, from Turin, in the north, to Naples, in the south, will be within receiving range.

But they do not expect so many Italians to see the first programs.

Manufacturers are trying to produce a set within the means of the "average Italian", who earns only £123 a year.

Imported sets from Britain and America would cost the "average Italian" his year's wages.

Radiomakers are working out hire-purchase schemes to attract customers.

Television was born in Italy in 1949, with one transmitter at Turin, though it had been conceived long before the war.

There are three studios operating in Italy.

A fourth is planned for Rome. The Rome studio will occupy some 3½ acres to the west of the city by the autumn of this year.

The State-controlled radio Audixione Italiana has sole rights to all television broadcasting in the Italian peninsula.

Pioneers of television in Italy are at present worried about money.

They borrowed heavily to get their experiments under way, and the capital expenditure on transmitters, studios, equipment, and training schemes has left them considerably in debt.

Comet II ready soon

BRITAIN'S latest challenger for the world's airline business, the Comet II, will soon be rolling off the production line.

The new jetliner is faster than the 490 mph Comet I, and can travel farther without refuelling.

First of a fleet ordered by BOAC, pioneer operators of jetliners, the aircraft is expected to fly in August.

Six more are in an advanced stage of construction at the De Havilland works.

Production lines have also been laid down at Belfast, in Northern Ireland, and Chester, in England.

Taking shape alongside the Comet II is the prototype of a still faster and much bigger plane—the Comet III—which has won Britain her first American order for jet-airliners.

Three of these 58-86 seater aircraft have been commissioned by Pan-American Airways, which has an option on a further number.

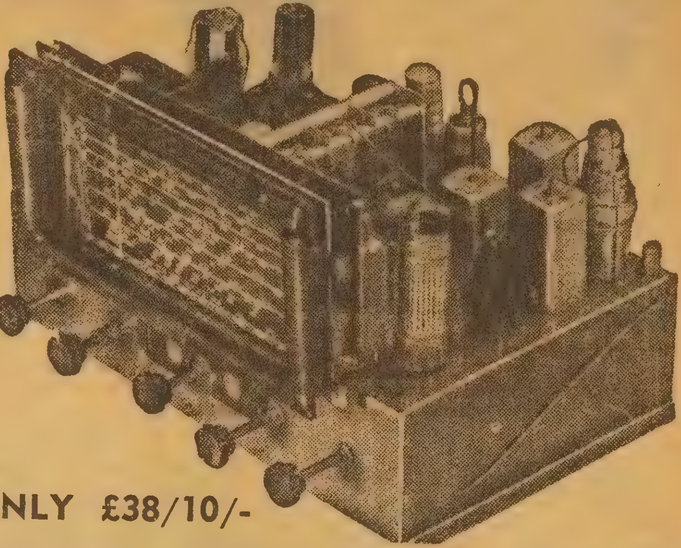
BOAC, which has ordered a big fleet of Comet III's, will soon begin exploration of the Atlantic upper air, about which little is known, in preparation for the time when this giant model comes into service.

This experimental work will be done with a Comet II, probably late in the coming autumn.

Experts summing up Britain's prospects of maintaining the lead in jet development think she is still four years ahead of the world.

The Cheapest Ready To Use Radio Ever Offered — Battery Operated — No Power Needed. Available For Cash Only. Country Orders Freight Extra.

1 valve mantel model radio in leatherette covered case 6½in x 4½in x 5⅝in with headphones and batteries £7/16/-. Also available in a leatherette covered portable case 9in x 5in x 6in. £8/10/-.
2 valve mantel model radio in leatherette covered case 8in x 5¼in x 2¾in with 3½in speaker and batteries £9/17/6, or in a leatherette covered portable case 9in x 5in x 6in £10/10/-.
Ideal sets for use in hospitals or as a second set for household use. Battery life approximately 6-9 months. Replacement batteries 22/3 per set. Country clients please allow for freight.



ONLY £38/10/-

FOR THIS 8-VALVE DUAL WAVE RADIO

Here's value only to be found at Radio House Pty. Ltd. This ready-made and tested chassis is complete with valves and 12in permagnetic speaker. Complete in every detail, it's easily fitted into your radio or radiogram cabinet and can be supplied with a polished wood front panel. Ideal for overseas reception, fitted with phono pick-up terminals, and has two separate tone controls for treble and bass boost. Size 16in x 10½in x 9in high.

SOUND AMPLIFIERS

The Phonograph Pick-up and Microphone

240 volt A.C. models complete ready for use (without cabinet, microphone or pick-up).

3 valve with 8in speaker £12/17/6 (suitable for phono pick-up only 3 watt output). 12in speaker £1 extra.

4 valve midget with 8in speaker £13/15/- (suitable for phono pick-up and microphone 4 watt output). 12in speaker £1 extra.

5 valve with 12in speaker £21/10/- (suitable for phono pick-up only 8 watt output).

6 valve with 12in speaker £25/-/- (suitable for phono pick-up and microphone 12 watt output).

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Swiss-made 240 volt A.C. record changers for 8 records — crystal pick-up **£12/7/6.**
"Tynor" door chimes **£2/10/-.** Reduced to **25/-.** Shopsoiled.

"Scope" electro-plating set. Plates nickel, copper, tin and zinc. **49/6.** Gold **15/9** or silver **8/6** extra.

Wizard clip-on Lamp Holder Bracket with ball and socket swivel. All metal. suitable for workshop or bedlamp 7/6.

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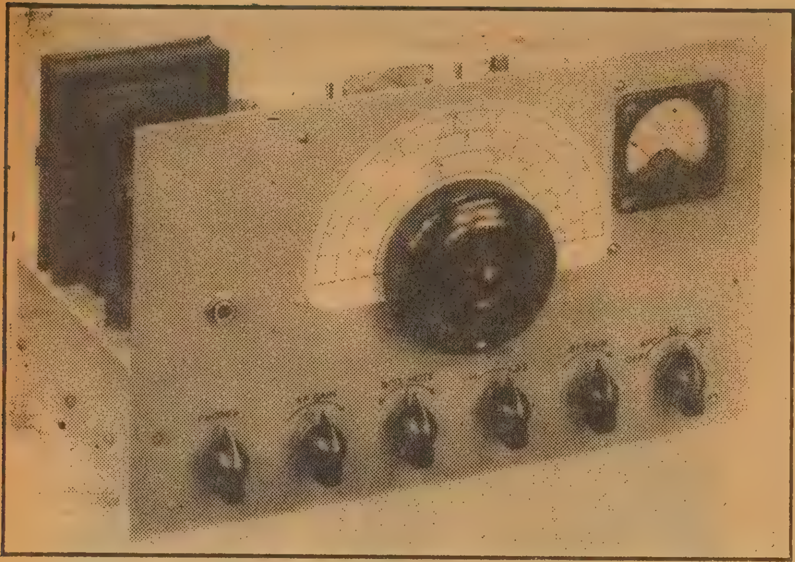


A front view of the set shows changes from last month. The phone jack moves up the panel, a tone control takes its place, and a tuning meter is added. The dial card is calibrated in Indian ink, and pasted to the panel. Lettering is also in Indian ink on grey lacquer finish.

A 3-BAND AMATEUR RECEIVER

Simple band switching, high selectivity, and good stability make this the smoothest "small set" we have built yet. Its performance is probably as good as one can expect without more complicated designs, using an RF stage. With ample bandspread on three bands, BFO, phone jack, tuning meter and noise limiter, it does all the essential things you want in a short wave set. Many of the parts come from the disposals counters, and quite a wide range of valves can be used with good results.

by John Moyle

LAST month we described a two-valve shortwave receiver designed primarily for amateur use on the 3.5 and 7 Mc bands. It used quite a simple circuit from which good performance could be extracted without the use of special type valves or components. In fact, a feature of the circuit was that many ex-disposals valves and parts could be employed, and many were used, in the original model.

BAND SWITCHING

Operation was greatly simplified by using a switched-band arrangement with only one set of coils. These were designed for the 7 Mc band, and when a change to 3.5 Mc was required, extra fixed capacitance was switched across the coils as the alternative to using a second set. Trimmers were fitted for each band to allow alignment, and a padder to keep the circuits reasonably in track over the 3.5 Mc band. The fact that L/C ratios are not very critical at these frequencies meant that the set's performance on 3.5 Mc did not suffer to any appreciable extent.

The set used a noise-limiting circuit of a standard type employing the 6H6, which is at present so cheap to buy that it can hardly be classed as an extra valve, as far as cost is concerned. Finally, a BFO was included, and a power supply. For those who built the companion two-band transmitter described in the June issue, it would be quite practicable to use its power supply for the receiver, switching across for transmitting or receiving.

Now it is a well-established fact that, sooner or later, one gets the urge to add to any simple circuit to improve its flexibility or performance. Amateurs are no exception to this rule — it might even be said that they created it! For that reason, the chassis layout was arranged with extra holes for some obvious additions already punched, which can be blanked out until they should be used. The set, too, was laid out so that certain additions could be made without seriously upsetting the existing wiring or component mountings.

The purpose of this article is to represent the set in an expanded form, with all the additions necessary to produce from it all it can give, not forgetting our original idea that cost and complexity should be kept at a minimum. During the description, we will take the opportunity to elaborate on one or two points in design and construction which will apply not only to this set, but to others you may build from time to time. A little repetition from last month may be unavoidable, remembering that readers of this article may not have last month's issue easily available.

THREE BANDS

Looking through the circuit, the coil assembly is essentially the same as that used last month. The same coils are used for 3.5 and 7 Mc, and the same condenser values. We have, however, added a second set of coils to cover the 14 Mc band.

It might well be argued that these three bands just about exhaust the usefulness of this type of simple set consistent with good performance. The higher frequencies may need more gain than we have here, together with greatly accentuated problems of band coverage and tuning arrangements generally. Today they are frequently covered by separate converters feeding into a receiver to form a double conversion arrangement. This set would do very well as the receiver in such a scheme, using a frequency of about 7 Mc for coupling the converters. So that it could form the basis of a highly efficient receiving system for which no apologies need be made.

USE ON 14Mc

Operation on 14 Mc isn't quite as good as it would be with an RF stage, but the difference isn't as great as one might think. The gain is such that a signal of one microvolt makes an appreciable impact, and that is quite a useful sensitivity. Image rejection isn't as good as with an RF stage, being about 4-1 at the worst spot. But because the oscillator operates on the low frequency side of the signal, the 19-metre shortwave stations which normally kick up such a racket in a dual-wave receiver are avoided, and in practice, very little interference is experienced by odd commercials running on the low side of the band.

But even an RF stage won't eliminate all images under today's operating conditions. For complete freedom, a double conversion set is necessary, and that leads to a great deal more complication than we have here.

There isn't as much overall gain on 14 Mc as there is on the lower bands, but the extra IF stage we have added makes up for that. If you add the extra band without the extra IF stage you may find that the weaker signals are a bit below par.

COIL TRIMMERS

Adding the 14 Mc coils isn't at all difficult, as the wave-change switch already has the vacant switch positions waiting to be wired. You will have to switch the aerial lead now, but again there is an available section for it. You will find the coils will sit on the chassis at the other side of the switch, and are secured by a brass bolt. We used plastic formers which you can buy fitted with iron slugs if you like, but ordinary formers can be used with wooden plugs cemented in one end to take the mounting bolt. If you follow our winding data, the iron slugs shouldn't be necessary.

Because we now have two more coils, we will also require two more trimmers. So we made up another small angle bracket from scrap copper (or brass or iron) and mounted them close together in line. We used the Philips screw-type, mainly because others may be too large physically, and because these trimmers are very efficient.

The mounting bracket is bolted to the chassis in the position shown in the illustrations and leads run across to the coil switch. The 100 pf condensers for the 3.5 Mc band and the padder are soldered to the bracket before it is mounted. Our photograph shows how the entire assembly looks prior to mounting. You should have no trouble with it if you follow our method.

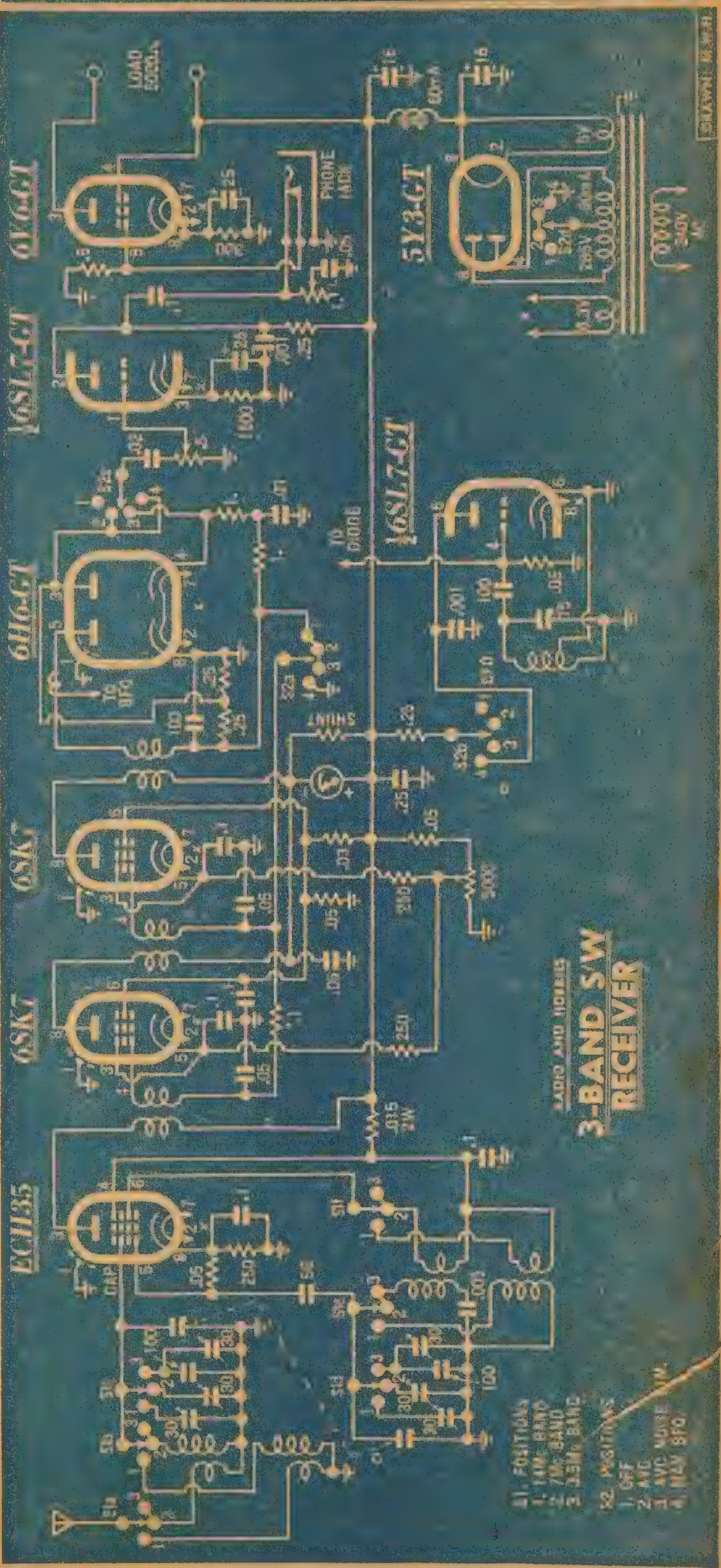
There is no padder used for the 14 Mc band, as the band coverage is small and the selectivity of the aerial circuit isn't high. Tests show that only the tiniest adjustment to the aerial circuit is needed across the band—so small as to be negligible. A padder could be included at the grounded end of the oscillator coil if you would like to experiment. About .004 mfds would do.

BANDSPREAD

The tuning condenser is made from a two-gang disposals type, with all the moving plates removed from each section except one. An old broadcast gang will do, if of standard size. The smaller gangs may need two moving plates to give coverage, and you may have to experiment with them.

The bandspread of the condenser will be enough to accommodate the 3.5 Mc band with almost full 180-degree rotation, and the width of this band limits the reduction we can make in tuning capacitance. Were it not for this fact, we could cut these plates down to at least half size, and improve bandspread on the other bands. But the position

CIRCUIT OF 3-BAND RECEIVER



Study the circuit and you will see that it is not at all complicated. The valves shown are preferred types but others may be used successfully.

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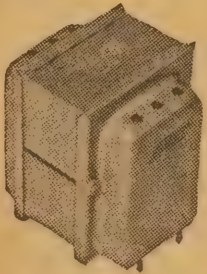
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Type No.	Minimum Inductance Normal DC	Normal D.C.	Normal D.C. Resistance	Normal D.C. Voltage Drop	Total Weight
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CF 101	30H	25 M/A	870 ohm	22V	1lb.
CF 102	15H	60 M/A	300 ohm	15V	1lb.
CF 103	30H	60 M/A	420 ohm	25V	2lbs. 6ozs.
CF 104	30H	75 M/A	580 ohm	43V	3lbs.
CF 105	15H	80 M/A	250 ohm	20V	2lbs. 6ozs.
CF 106	12H	100 M/A	200 ohm	20V	2lbs. 6ozs.
CF 107	30H	100 M/A	360 ohm	20V	4lbs. 1oz.
CF 108	12H	150 M/A	135 ohm	36V	4lbs. 1oz.
CF 109	20H	150 M/A	225 ohm	34V	5lbs. 4ozs.
CF 110	12H	200 M/A	100 ohm	20V	6lbs. 12ozs.
CF 111	16H	200 M/A	165 ohm	33V	6lbs. 12ozs.
CF 112	10H	250 M/A	70 ohm	18V	6lbs. 12ozs.
* CF 113	20/5H	250 M/A	70 ohm		6lbs. 12ozs.

*SWINGING CHOKE

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COMPASS GENEMOTORS. Input 28 volts. Output 230 volts at 100 mA. New
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VIBRATOR TRANSFORMERS. 12 volt to 350 volts at 100 mA. Brand new.
10/-

KESTER SOLDER PASTE. 2oz tins
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PHONE JACKS. Metal Army type
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VIBRATOR CARTRIDGES. 6 and 12 volt. Used but all tested
5/-

TRANSFORMERS for Carbon Microphones
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SPEAKER TRANSFORMERS. Small type. 10,000 or 20,000 ohms. 2/-

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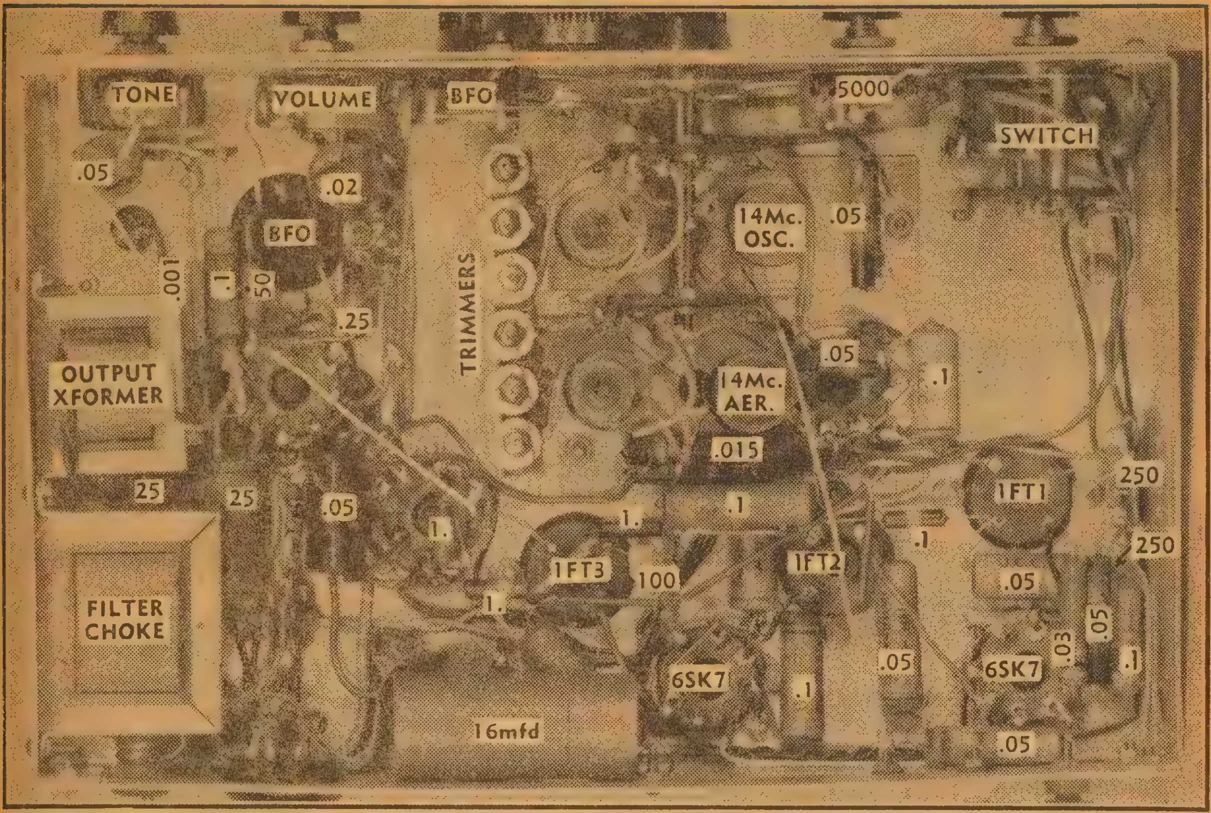
UNDER CHASSIS VIEW OF THE 3-BAND RECEIVER



This picture shows the layout of the coils, trimmers and many other components. Use tag strips to support odd parts and make grid and plate leads as short as possible. Miniature components make a neater job, but are not essential electrically. Aerial coils are to the left of the switch, oscillator coils to the right.

isn't as bad as it looks, for the following reason:

In practice, we can avoid cramping the 7 and 14 Mc bands by tuning them with the condenser toward the minimum capacitance end, where the plate shape gives much greater spread than at the maximum end. The 7 Mc band occupies more than 1½ inches, and the 14 Mc band more than two inches. With a slow-motion dial, this is quite a useful amount, and avoids too much "dial-winding". Remember that bandspread doesn't increase selectivity. If it is enough to make dial reading easy, there is little point in overdoing it. On the 3.5 Mc band, the spread from 3.5-3.6 is not nearly as great as 3.7-3.8, but it is still enough. The use of a cut-down gang has given us automatic mechanical bandspread at one end, with enough coverage over-all to accommodate the entire 3.5 Mc band. The great rigidity of the gang as compared with a pair of ganged midgets is well worth while, and mechanical rigidity is vital if calibration is to remain accurate.

In practice, stability is very good. Warm-up drift is small on 3.5 and 7 Mc and very little more on 14. Given a solid chassis, rigid leads in the oscillator circuits, and a well-made assembly, calibration will not alter by more than a whisker.

We have not used a separate oscillator, although there is a socket hole provided, because we couldn't see much advantage in so doing.

PARTS LIST

1	panel 12in x 7½in
1	chassis 11in x 7in x 2½in
1	vernier tuning dial
1	special 2-gang condenser
1	3-plate variable condenser
6	3-30 pf trimmer condensers
1	power transformer 285V 60mA HT, 6.3 & 5V filament windings
1	60mA filter choke
1	2-bank 3 x 3 switch
1	2-bank 2 x 5 switch
3	455 Kc intermediate transformers (low gain)
1	455 Kc BFO coil (see text)
1	ECH35
2	6SK7-GT
1	6H6
1	6SL7
1	6V6-GT
1	5Y3-GT

RESISTORS

3	1.0 meg. ½ watt
1	1 meg potentiometer
1	.5 meg. ½ watt
1	.5 meg potentiometer
4	.25 meg ½ watt
1	.1 meg. ½ watt
2	.05 meg. ½ watt
1	.05 meg. 1 watt
1	.03 meg. 1 watt
1	.015 meg. 2 watt
1	1500 ohm ½ watt
1	5000 ohm ww potentiometer
1	300 ohm 3 watt ww
3	250 ohm 1 watt

CONDENSERS

2	25 mfd 40 pv electrolytics
2	16 mfd 525 pv electrolytics
1	.25 mfd 400V paper
3	.1 mfd 200V paper
2	.1 mfd 400V paper
2	.05 400V paper
2	.05 mfd 200V paper
1	.02 mfd 400V paper
1	.01 mfd 400V paper
1	.005 mfd mica
1	.001 400V paper
2	100 pf mica
1	50 pf mica

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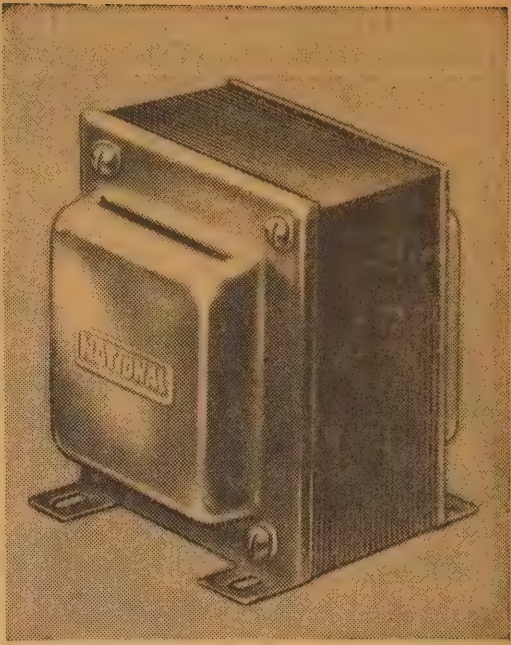
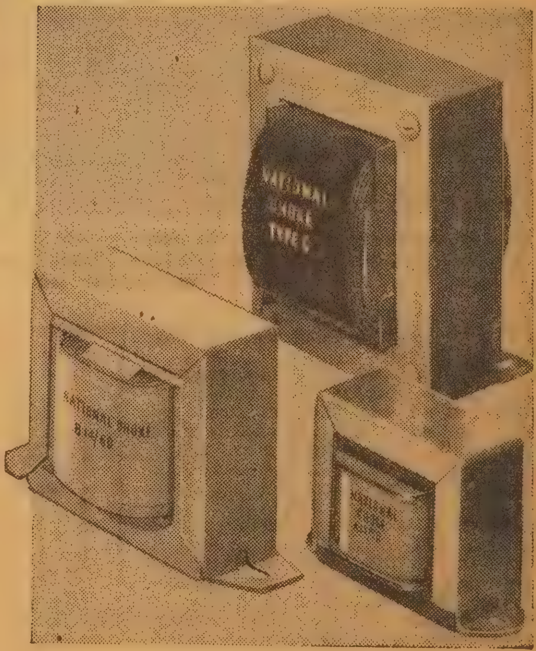
B.14/60	14	60	520	13/9
C.20/60	20	60	500	25/5
D.30/60	30	60	600	45/-
C.15/80	15	80	430	42/11
E.20/80	20	80	300	45/-
E.30/80	30	80	380	48/5
F.15/100	15	100	300	45/-
F.15/125	15	125	250	59/-
F.15/150	15	150	200	67/-





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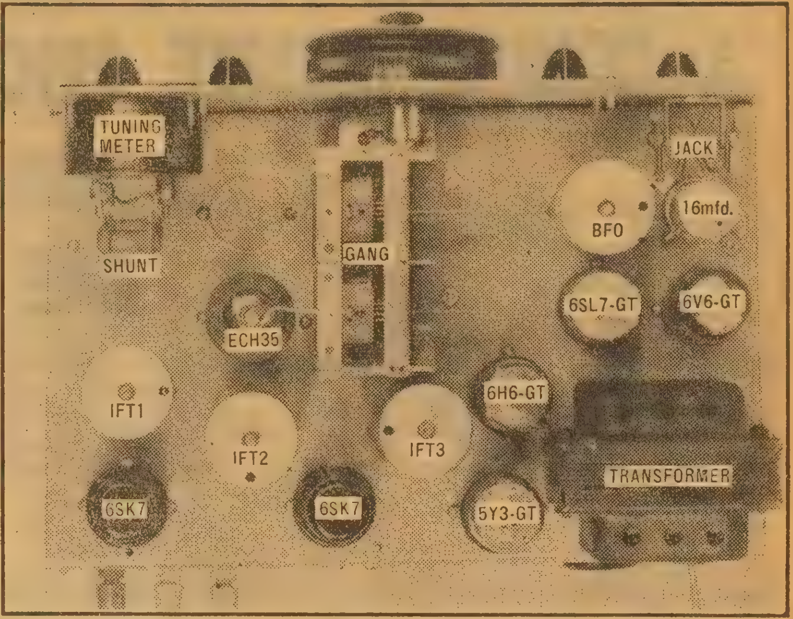
PLAN VIEW OF 3-BAND RECEIVER



The original chassis carried the necessary holes for an extra I.F. stage, also a separate H.F. oscillator which we have not used. Blueprints are available.

Please yourself about it, as the circuit changes are very slight.

The 6K8 is still OK as a converter, although any of the standard types can be used. Perhaps the best would be the ECH35 or X61M, which have a higher conversion and can be plugged into the same socket with no circuit alteration. Some other types would need separate feed for screen and oscillator plate.

The next section is the IF amplifier which uses two stages instead of one as in the original. The main reason for two stages is to improve the selectivity of the set. With one stage, we must extract the maximum gain by using a high-gain valve and high-gain intermediates. Normally a high-gain IF is made by using plenty of turns on the coils and a smallish parallel condenser. The tight coupling between circuits tends to widen the selectivity peak and broaden the skirt of the curve, so that a high-gain single stage is almost automatically less selective than we would like.

MORE GAIN

Adding another stage removes any doubt about gain—in fact, we must use lower gain IF's to avoid oscillation at optimum sensitivity. Even with standard valves, such as the 6K7, three standard IF's will spill over despite complete decoupling.

Normally, low gain, higher selectivity transformers are made by using fewer turns and a higher parallel condenser. Sometimes the coupling between the coils is physically reduced as well. The lowered inductance of the circuit reduces its dynamic impedance and hence the volts developed across it, but the higher C increases the Q, sharpening the selectivity peak and narrowing the skirt. Because such a transformer is inherently more selective than the higher gain types, and because there are three of them instead of two, a very marked selectivity increase takes place, with a much better rejection of strong carriers.

Such an IF line-up will have an overall gain substantially greater than a single, high-gain stage. But its main usefulness is to produce a selectivity characteristic several times better.

Now, although the ideal would be to buy three low-gain, high-selectivity IF's, you may have a number of standard types you'd like to use. Most IF's from disposals equipment with two IF stages, such as the Type 11 or 22 sets, can be used "as is", for they were designed that way. But IF's intended for single-stage broadcast sets are a different proposition.

MODIFYING IFT'S

You can often transform high-gain into low-gain IF's merely by removing some turns from the coils and adding more C in the form of small fixed condensers. To illustrate the point, RCS have agreed to the publication of some design figures of their transformers.

The normal high-gain IF used in the first stage has Litz-wound coils of 290 turns tuned with built-in 70 pf condensers. The slightly lower-gain type meant for the second stage has 250 turns with 100 pf transformers. Alignment in both cases is by an iron slug adjustable from top and bottom.

Now, although we can't do anything about increasing the spacing between the coils without wrecking the IF, we can reduce gain and increase selectivity by removing turns. The standard low-gain IF intended for use in two-stage IF circuits has 131 turns with condensers of 400 pf. So that if we take either of the first types, and remove the required number of turns, we can, by adding capacitance to make up 400 pf, convert them to low-gain types.

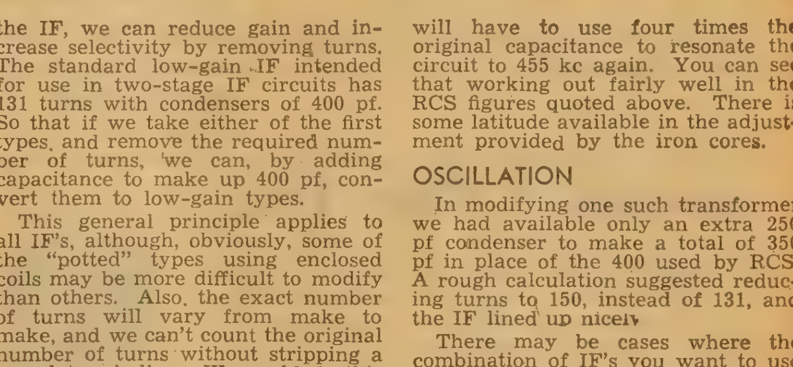
This general principle applies to all IF's, although, obviously, some of the "potted" types using enclosed coils may be more difficult to modify than others. Also, the exact number of turns will vary from make to make, and we can't count the original number of turns without stripping a complete winding. We could do this with the IF intended for the BFO circuit, assuming we wind on a new feedback winding to replace it. If so, we will have all the data needed to work on this turn-reduction business.

Remember that if we halve the original number of turns we reduce the inductance to one-quarter, so we will have to use four times the original capacitance to resonate the circuit to 455 kc again. You can see that working out fairly well in the RCS figures quoted above. There is some latitude available in the adjustment provided by the iron cores.

OSCILLATION

In modifying one such transformer we had available only an extra 250 pf condenser to make a total of 350 pf in place of the 400 used by RCS. A rough calculation suggested reducing turns to 150, instead of 131, and the IF lined up nicely.

There may be cases where the combination of IF's you want to use still causes the set to "spill over" at maximum gain. If the tendency is slight, extra decoupling might remove it. First of all, try feeding each IF valve with a separate screen feed resistor of, say, .1 mfd, by-passing each screen, of course. This is bound to improve matters. If still touchy, decouple the plate leads from the converter and each IF valve with



This picture shows the six trimmers soldered to a small metal bracket in addition to the padder and two parallel condensers of 100 pf for the 3.5 Mc band.

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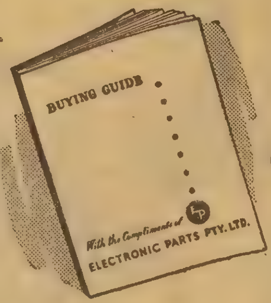

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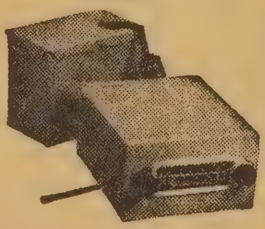

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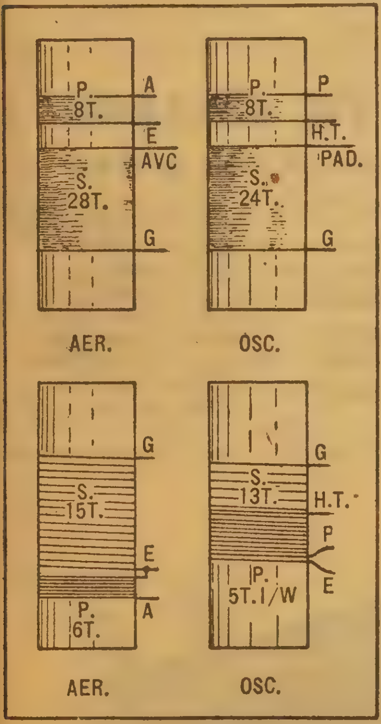
2000 ohms (value not critical if not too high) and .05 condensers. If there is any hope at all, this will stabilise the set. Should it still oscillate, reducing the overall gain still farther is the only cure, and you had better start working over one of the IF's to lower the gain a bit more.

With the full decoupling mentioned above, we were able to stabilise the set using two low-gain and one high-gain IF's, so that it would not oscillate on manual control with the RF gain wide open. Try to get your set this way, as regeneration in an IF stage should be avoided in a design of this type.

AVC CIRCUIT

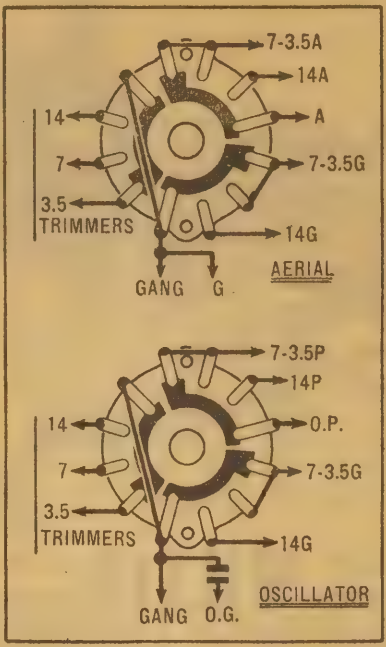
With three low-gain IF's you might achieve stability and an even simpler circuit by feeding the screens of the first three valves, and the oscillator plate, from a common point of 100 volts and a common resistor of about 10,000 ohms (2 watt). But as only a few extra parts are involved, probably from the junk-box, we suggest you stick to the circuit as we have described it. Remember oscillation is most likely caused by common coupling firstly in the cathode circuits, secondly, in the screen circuits, and finally, in the plate circuits.

The plate current of the IF valves is fed through a small disposals type meter which indicates signal strength by reading the change in combined plate current caused by the AVC action. The stronger the signal being received, the greater the current reduction. We used one of the 0-5 mA meters readily available, and shunted it so that with aerial connected and not tuned to a station, the meter read full scale. The value of this shunt will be between 10 and 15 ohms, depending on individual valve characteristics.



The coils are wound on ½ inch formers. The 7-3.5 Mc coils are close wound with gauge 22 enamelled wire. The same wire is used for the 14 Mc coils, the aerial spaced over ⅞ inch and the oscillator ¾ inch. The primaries are wound with finer wire, about 30 gauge. The ends are secured through holes in the formers, and the windings treated with coil dope or nail lacquer.

The converter is not AVC controlled, firstly to avoid frequency shift, which can occur, and second, to feed the maximum signal into the IF stages to give the largest meter swing. For the same reason, the IF screens are fed through a voltage divider circuit of two resistors to prevent the screen voltage from rising too high on strong signals, which would of course, partially cancel out the drop in plate current.



This diagram shows the connections to the coil switch wafers seen from the rear.

The detector noise limiter circuit is a most effective and simple type, and is invaluable in reducing static and ignition noises. It is also a great help against certain types of line interference, which can often drown weaker signals. Although this type is not generally used for CW, we found it worth while wiring the fifth function switch position to allow it to come in with the BFO, and have found it to assist almost as well as for phone signals.

The first audio amplifier is half a twin triode, the other half being the BFO. Last month we showed a BFO circuit using a modified IF transformer as the oscillator coil. This set uses the alternative cathode-tap oscillator favored by coil manufacturers. There is nothing to choose between them in performance.

One addition not shown last month is a condenser from the first audio plate to ground. This bypasses output from the BFO section of the valve which otherwise couples into the audio stage through the valve itself. It ensures minimum leakage into the circuit so that virtually all the coupling is through the tiny condenser made by looping two pieces of hook-up wire, one attached to the BFO

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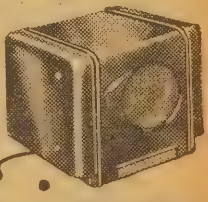

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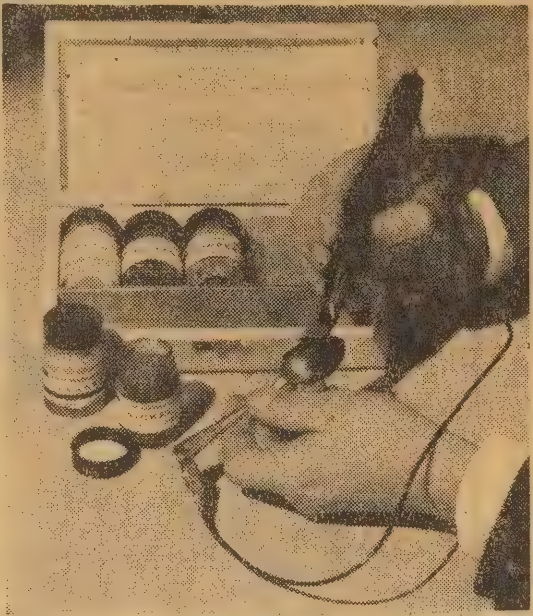

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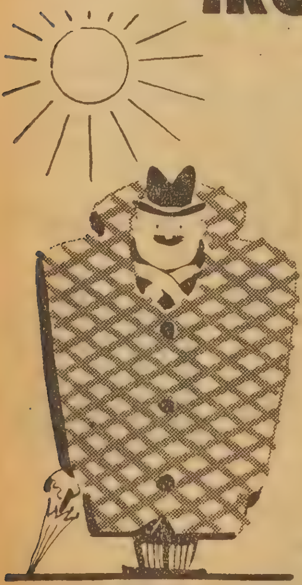

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grid and the other to the detector diode.

The small trimmer, which varies the BFO beat, has the tip of one plate bent over to short circuit it at full capacity. This is a simple way of cutting out the BFO on manual control if you want to, although it's not really essential.

CONSTRUCTION

There are no tricky points about building the set. The exact height of the tuning gang may be governed by the type of tuning dial you use, and frankly the choice here isn't great. The AWA type we used was taken from a disposals counter, and, although normally expensive is a very good one. There were some similar although smaller movements available on some ex-disposals English equipment earlier in the piece, and a few odd "Utility" and other panel-type dials to be had occasionally. Even a three-inch dial with a rubber tyre vernier attachment might do at a pinch, but most amateurs seem to find a reasonably good dial from somewhere.

The coils are quite easily wound, and with a little care can be spaced quite neatly. Ordinary ¾-inch bakelized former will do (and was used experimentally). The exact wire gauge isn't critical—anything from 20 to 26 will be OK, with 22 about the best. The primaries could be of the same wire, although 30 gauge is easier to use.

For accurate dial calibration, a good oscillator or Bendix-type meter is really needed, particularly as the condenser does not follow a linear scale. However, this applies to any short-wave receiver.

When lining up, see that the oscillator is set on the high frequency side of the signal on 3.5 and 7 Mc, and on the low side for 14 Mc. You will be able, no doubt, to tune in a strong signal at two settings of the 14 Mc oscillator trimmer—the right one to use is with the trimmer at the higher capacity. When the bands are guided to the best spots on the dial—we ended up with 3.8, 7.150, and 14.350 Mc all on the same reference point with the gang nearly all out—the aerial trimmers are adjusted for best signal strength. That's all there is to it. The IF's should be lined first of all at approximately 455 Kc. The exact frequency isn't critical, but they must all be in line. The AVC meter is very handy here, as it indicates maximum reading on a given signal when all the circuits are in line.

LAYOUT CHANGES

A slight re-arrangement of parts under the chassis gives a clearer view of components, but has no other significance. One of the filter condensers is now moved above the chassis near the output valve, although if your phone jack is a big one, you may not be able to fit it in. The choke we moved to one side, and also added a small speaker output transformer, so that only the voice coil comes away from the set. These are points about which you can please yourself.

We have also added a tone control from the far side of the audio coupling condenser, so that it will work on both phones and speaker. It is mounted where previously we had the phone jack. It balances the panel somewhat better, and is useful in some cases. The phone jack is moved up the panel above the chassis.

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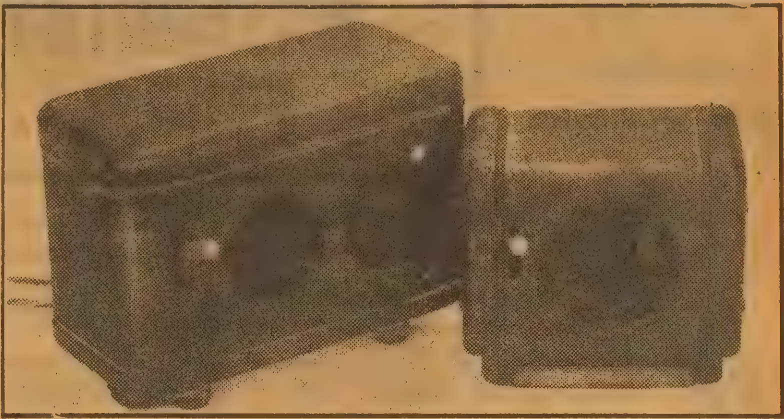

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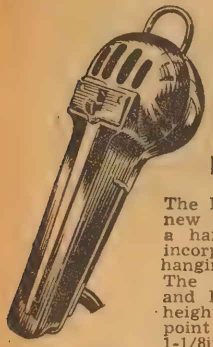

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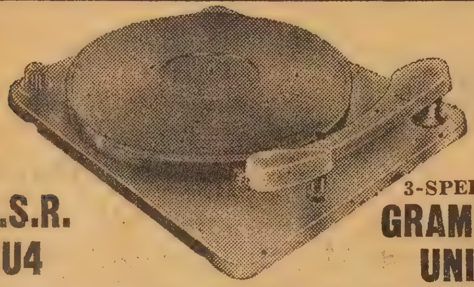

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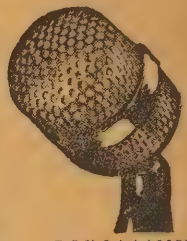

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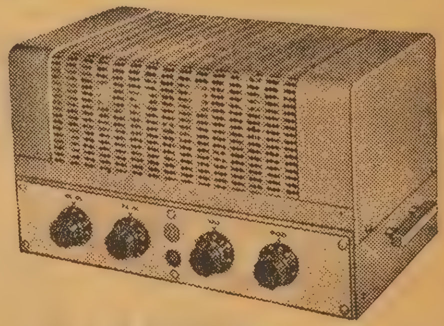

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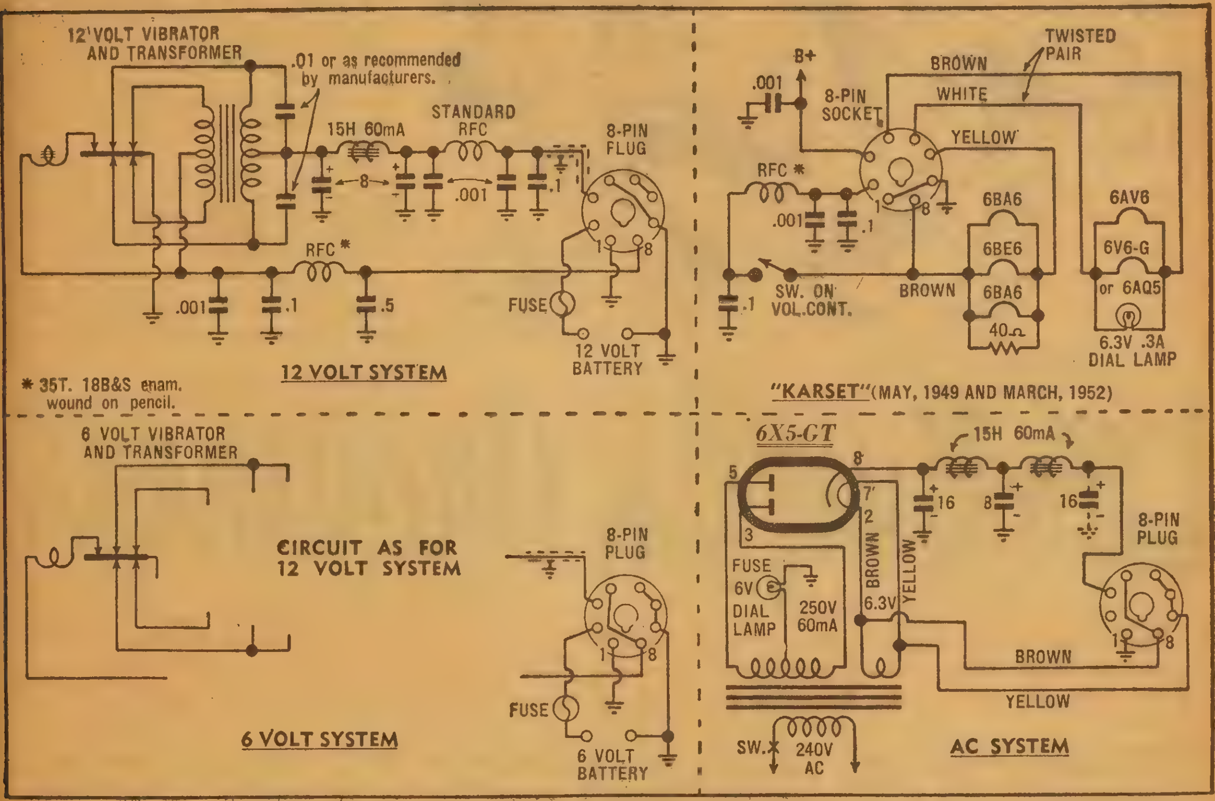
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8
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.1
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6 VOLT VIBRATOR AND TRANSFORMER
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8-PIN PLUG
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8
FUSE
6 VOLT BATTERY
6 VOLT SYSTEM
6X5-GT
5
8
7
2
3
15H 60mA
16
8
16
8-PIN PLUG
FUSE
6V DIAL LAMP
250V 60mA
BROWN
YELLOW
6.3V
1
8
BROWN
YELLOW
SW.
240V AC
AC SYSTEM

If you have ideas of operating your R & H Karset both in your car and in your home, here are some ideas on how to arrange it. Submitted by Mr. H. H. Cane of 89 Truganini Road, Carnegie, S.E.9, Victoria, the diagrams show the plug wiring of a 6 volt and 12 volt supplies, the wiring of an AC mains supply and the Karset socket wiring to receive any of these supplies.

THESE arrangements will apply to the R. and H. Karsets of the May, 1949, and March, 1952, issues because both sets operate with a separate power supply.

The 4-valve Karset of the April, 1953, issue is not adaptable to this scheme as it is a single-unit set, the power supply being an integral part. This design would need modification to enable alternative operation from an AC power supply and may involve experiment in case some "hash" interference problems were introduced.

Considering then, the 5-valve Karsets, the scheme requires an octal socket on the set itself. While this was the case with the 1949 Karset, the 1952 Karset carried a 6-pin socket.

The heater wiring within the set is grouped in two sections as shown in the top right circuit and both sides of each section taken to the socket. The dial lamp is now included in the heater circuit.

A 6-volt vibrator supply would follow the original circuitry except that the output plug would be wired according to the lower left circuit shown here. When plugged into the set, the heater circuit would be arranged automatically for 6-volt operation and all other functions would carry on as before.

The 12-volt vibrator supply has the same circuitry as the 6-volt version but the output plug is wired so that when plugged into the Karset, the heater circuit is arranged for 12-volt excitation. The wiring of either vibrator supply should follow the technique illustrated in the original articles in that a common earth point for all earth returns should be adopted as far as possible.

The AC power supply is quite straightforward, the output plug being wired so that the Karset wiring is arranged to suit. The color coding on the wiring is simply to assist you in following the leads.

With a 250-volt 60 mA rating on the secondary winding of the power transformer, the high tension would be about 240 with the two chokes in the filter network and just under 260 volts with only one choke in the filter. The last section in the filter is shown dotted in the diagram as optional components if further hum reduction is desired.

A 225-volt 50-mA transformer would provide about 230 volts HT with one choke in the filter. A 285-volt 60-mA transformer would provide over 280 volts HT with two chokes. This could be reduced to about 250 by connecting a resistor of value from 150 to 175 ohms between the rectifier cathode and the junction of the first filter capacitor and the first filter choke.

Let's Buy An Argument

When it comes to arguing on paper, there's never a dull moment. One is either holding forth on some controversial matter or standing, back to the wall, in defence of one's honor. Right now, it seems, my honor is at stake over the simple matter of a meter scale.

by W. N. Williams

LEST you forget where all this started, let me briefly recount the circumstances.

In the May issue (page 73), we published a letter from a reader who was much encouraged by results he had obtained from a relatively simple amplifier set-up.

By way of a test, he had disconnected his speaker voice coil from the amplifier, substituting for it a 3-ohm resistor. Across this was connected a multimeter, set to the 10-volt AC range and measuring output voltage. Actual readings, however, were taken from a decibel scale on the meter face.

FLAT (?) CURVE

The amplifier gain was turned full on and the pickup allowed to play through a standard frequency recording. By plotting meter reading in decibels against frequency, he obtained an impressively flat overall response curve.

In fact, the curve looked suspiciously flat for the particular set-up and I suggested that this reader, along with others, had probably made the mistake of testing the amplifier too close to the maximum power region. Thus the waveform simply flattened off on peaks instead of showing a marked rise in output voltage.

In support of this contention, I suggested that the "0 db" point would occur at about mid-scale on an ordinary multimeter, representing about 5 volts AC. The actual value quoted was 5.8 volts—a figure that seemed to support my recollection of things, but obtained from another type of scale altogether.

This order of voltage, present across a 2 or 3-ohm load, would certainly represent a near overload of an ordinary P-P 6V6 amplifier.

The whole story seemed to hang together so nicely.

There the matter rested until a reader (in the July issue) pointed out that there could be no possible justification for "0 db" occurring near the centre of a 10-volt AC range. He quoted a variety of "standards", all of which would put the "0 db" point down near the low voltage end of the range. The chance of overload during the tests would, therefore, be remote.

Well, I checked through the various reference standards mentioned, plus a couple more for good measure. The correspondent, JDC, was dead right.

MUST BE WRONG!

I rang a friend who lives his life among meters. He had much the same story to tell — nearly all decibel reference points occurred well down on the scale and, in point of fact, he didn't recollect any that occured around the 5 volts mark!

In the face of all this, I could only conclude that my memory had let me down; that there was no justification for the overload theory. So, cap in hand, I said as much in the last issue.

But, hardly had the presses stopped rolling when a member of the staff came to light with a standard multimeter scale having the "0 db" point right there in the middle of the range and equivalent to 5.5 volts AC on the 10-volt scale.

At least my memory was exonerated.

What was more to the point, a check revealed that this scale had been fitted for many years as standard to a local range of multimeters. The "0 db" point had been placed near the centre of the range for the benefit of radio servicemen, who allegedly preferred it in that position.

NEW REFERENCE

Instead of putting "0 db" in the exact centre of the scale, purely on the score of convenience, its position was based on a reference, so I was told, of 50 milliwatts across 600 ohms. Thousands of these meters had been made and sold.

Since then, this same manufacturer's zero decibel reference point has reverted to one of the more traditional "standards", out of deference to public utilities, who apparently buy a lot of multimeters.

So, perhaps, both JDC and I can retire from the field with honor unsullied.

There certainly was a meter in popular use with "0 db." in the middle of the scale. In view of this, and other statements in the original letter, it seems more likely that the reader originally concerned did run into overload troubles. Even if he didn't, other readers could easily do so, using the same general set-up and the same type of multimeter.

At the same time, JDC had ample grounds to query my statement, because the meter is not calibrated according to one of the accepted standards. The manufacturers chose another course, presumably because their serviceman customers preferred it that way.

Such a step is perfectly legitimate, I suppose, because decibels are fundamentally a means of expressing power ratios and not absolute levels.

LOAD IMPEDANCE

To change the subject completely, our correspondent B.M.B. opens up a question which is frequently raised (with variations) in our query service . . . . What happens when I do various things to speaker voice coil circuits?

His comment stems, of course, from a discussion of speaker matching in the June issue.

By and large, the answers to most queries of this nature relate back to a few basic truths and it may be interesting to comment in broader fashion than required by this particular letter. If the comment sounds rather involved and inconclusive, I can but apologise.

The most familiar query follows along the lines, "Is it permissible to extend the leads to a speaker voice coil and, if so, over what distance?"

The usual and elementary approach is to consider it purely as a problem in resistance values.

Thus, you take a tape measure and run it over the shortest route that the proposed extension lead would have to follow. You then double it to obtain the total length of wire in the circuit.

You next decide on the thickest wire that can reasonably be installed. By checking the gauge and the number of strands against wire tables—so many ohms per thousand feet—it is possible to predict the DC resistance of the line.

TYPICAL CASES

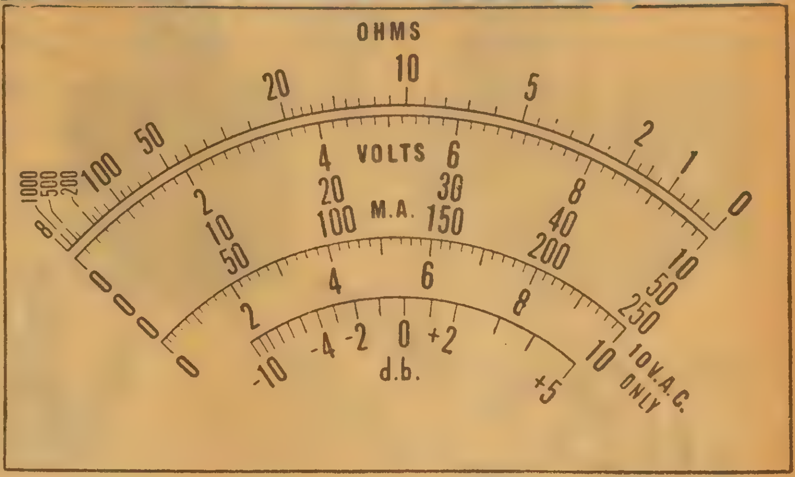
Let's say it works out at 2 ohms. If this has to be inserted in a 2-ohm voice coil circuit—due to the choice of speaker and transformer—there must obviously be some division of audio power between the speaker and the line. Whether it matters or not will depend on how much volume you want from the speaker, how sensitive it is, and so on.

Most likely you would reckon the instalaltion to be quite workable.

By way of contrast, however, you might attempt to run the same circuit in bell wire, only to find that it works out to, say, 10 ohms resistance, with a really serious loss.

Or, again, if you happened to be concerned with a 15-ohm voice coil circuit, a 10-ohm line wouldn't matter so much. In fact, 10 ohms extra in a 15-ohm circuit would be less serious than two ohms extra in a 2-ohm circuit.

CAUSE OF MUCH CONTENTION!



Unusual feature of this scale, which was fitted to a popular line of multimeters, is the position of the "0 db." mark. If nothing else, it provided us with material for an unexpected argument.

That is the simple approach, but it is only part of the story. There are at least two other considerations which complicate the end result and explain why things don't always seem to work out "in practice". Perhaps I should say "three other considerations".

A MORAL?

While not wishing really to get involved in "Buying an Argument", I must put in a small spoke on output impedances.

I have a general purpose 8 watt amplifier, and a 70 watt job, the latter being more for audio power testing than anything else.

The small one was designed (P.P. 6V6's, with 300 volts incidentally) to deliver power from below 20 cycles to 30 Kc with no movement on the V.U. meter. It has about 25 db of linear feedback, on the power stage, preceded by equalisors and whatnot. The output transformer is a modest OP9 Ferguson.

At two watts, I can't measure any appreciable distortion, of any type. The silly feature is that the 2 ohm output is operating into a relay controlled line into a 20 ohm potentiometer, working as a distant volume control on a Rola 120X.

So far as I can see, the quality on all settings of the 20 ohm potentiometer is identical. So much for impedances — up to a point.

The large amplifier, at two watts, turns out a superior performance at 600 ohms, thence 12.5 ohms, into a less exact speaker, an Amplion AU41. The treble range is of course much inferior to that of the 120X. However, if a potentiometer is inserted into the AU41 voice coil — 100 ohms to keep the same ratios as with the other amplifier — the quality deteriorates vastly. The final tubes are Class B 807's, flat out, with no feedback. There seems to be a moral somewhere.

—B.M.B. (Rainsworth, Q'ld.)

The first is the output impedance of the stage feeding the extension speaker.

If the stage is an uncompensated pentode, its output impedance at the transformer secondary may be several times the nominal load figure, due to the valve's high plate resistance.

In a 2-ohm secondary circuit, the "generator" impedance may easily be 5 or 6 ohms and it begins to look like a constant current network.

In any case, the audio current through the secondary circuit—and therefore through the voice coil—will be a function of the net circuit impedance—say, 5 ohms, plus 2 ohms.

If you add another 2 ohms, representing the line resistance, the total secondary circuit impedance merely increases from 7 to 9 ohms. ohms.

SMALLER LOSS

As a result, the audio current through the speaker diminishes by a smaller ratio than one might anticipate and the drop in volume may barely be noticeable.

At the other extreme, one may consider an output stage using a triode or a pentode with feedback. In this case, the generator impedance will be substantially less than the load, giving a total secondary circuit impedance of—say—1 ohm plus 2 ohms.

If an additional 2 ohms of resistance is added to the circuit, the total inpedance will now rise from 3 to 5, which is a larger ratio than from 7:9. There will, therefore, be a greater reduction in audio current through the voice coil and a more obvious loss of volume.

One could probably spend a lot of time with load lines and such like investigating this matter further.

The point of the matter is that the precise effect of resistance in the voice coil circuit is dependant to a degree on the output characteristics of the amplifier.

Then there's another thing: The true impedance of a voice coil only

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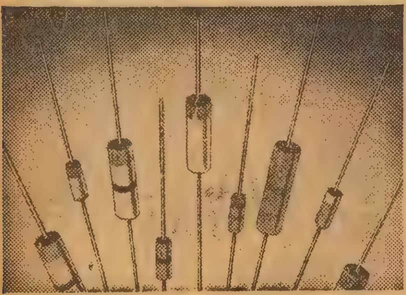

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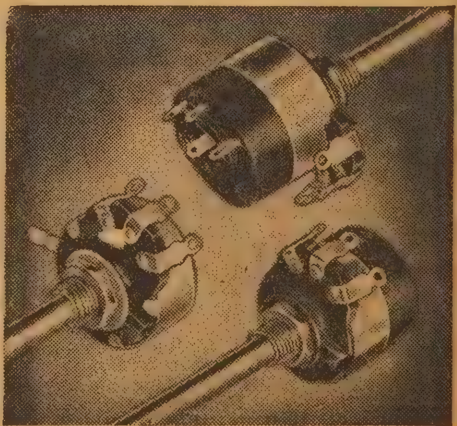

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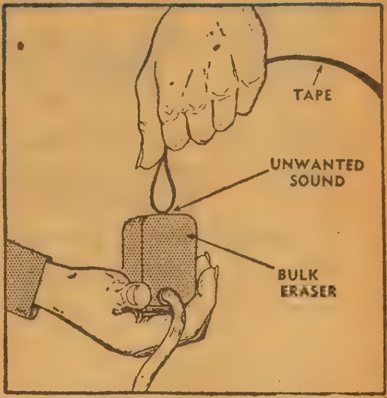
ANOTHER TIP FOR TAPE FANS

Single syllables, plops, &c., can be eliminated from a piece of tape dialogue by using a bulk eraser as shown. Run the faulty passage past the playback head a few times until you can anticipate and mark with a pencil the exact spot on the tape where the unwanted sound occurs. Now switch on the bulk eraser, hold the tape in a loop with the marked spot prominent and simply bring it lightly in contact with the face of the eraser. Don't switch the eraser off until the tape is well out of the way. If you are careful, it is entirely possible to erase a single "plop" or even wipe the "s" off the end of a word. It's a much cleaner method than cutting the tape.



approximates its nominal value in the middle of the register. Elsewhere it may rise to several times the published figure. Consider what this means.

We might decide that an extra two ohms of resistance will drop the power by about two to one—where the voice coil impedance is two ohms!

At the treble end particularly the voice coil impedance may easily rise to, say, 10 ohms. In this region the extra two ohms would make very little difference indeed.

In other words, additional resistance in the voice coil circuit doesn't just introduce a "flat" loss. The loss tends to be greater in the middle register than at the extreme ends—particularly the treble end.

As a result, the reproduction becomes progressively more shrill as the total circuit impedance rises.

The third factor has to do with the change in load on the output stage. If it is matched correctly into a two-ohm voice coil there will obviously be a considerable mismatch if the minimum secondary load is boosted to, say, four ohms by the addition of line resistance.

CHANGES IN LOAD

Valves react differently to changes in output load, and also according to whether the stage is operating at moderate or near-maximum output.

Triodes and feedback amplifiers do not react unfavorably to higher output loads except where maximum rated power is called for.

Pentodes (and tetrodes) "au naturel" are much more touchy, load variations either up or down resulting usually in reduced power and higher distortion.

Class AB2 and class B stages are particularly critical, due to the transition effect between valves during certain portions of the cycle.

By the time you link all this together it isn't hard to rustle up enough theory to explain almost any observation.

Let it be said, however, that the person who hopefully instals an extension speaker isn't likely to be bothered too much by things that can happen. Provided the line resistance is kept down to about the nominal voice coil impedance the extension unit will work fine.

Where you can run into strife is in connecting volume controls into voice coil circuits. The controls can't afford to have too low a resistance, due to shunt losses, but high values insert excessive resistance in series with the voice coil.

THIS HAPPENS . . .

As a result:

(1) The amplifier is improperly terminated, which may compromise its ability to deliver adequate power for an acceptable amount of distortion.

(2) The amplifier is turned up farther, anyway, for a given volume than it would be if the voice coil were connected straight through.

(3) The damping in the speaker is less effective—a point I have not mentioned before.

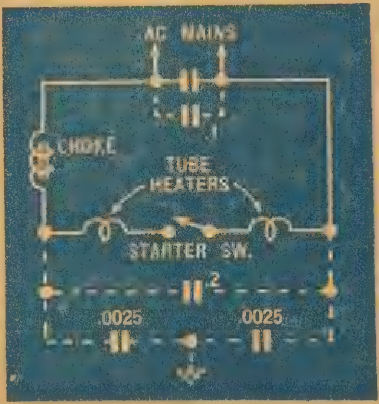
It follows, almost as a matter of course, that a simple voice coil type volume control must compromise results to some extent. The only problem is by how much.

In the case of the 6V6 amplifier mentioned by B.M.B., the distortion level at moderate volume would probably not suffer at all due to the increase in output load. The feedback would see to this. He mentions "about 25 db of feedback", but there would probably be effectively more than this with the abnormally high load impedance in the output circuit.

We are thus faced only with the results of feeding the speaker from a high source impedance: (1) an unnatural treble emphasis and (2) a deterioration of transient response due to poor electrical damping.

Apparently neither of these effects was severe enough to be objectionable. In fact, the rising treble could be corrected easily enough with a tone control.

The same two effects would be present in the other amplifier but, in addition, I imagine that it would take much less kindly to a mismatched load.



A circuit, supplied by a New Zealand reader for suppressing interference from fluorescent lights.

Not only is it a class AB2 affair but it has no feedback and is working into a 600 ohm output link. Unless properly terminated at the far end it would have to look into a rather formidable array of inductors.

A speaker load is problem enough for such an amplifier, but a random conglomeration of L, C and R may be just too far over the odds.

Even the modest power requirements mightn't help because class B — and to some extent class AB2 — amplifiers have relatively high distortion at low power levels. And, of course, unnatural frequency response, due to factors already outlined is independent of level.

In the face of all this, B.M.B., I'd say that there certainly is a moral somewhere. Several morals, in fact!

A couple more observations and I'm through.

Some readers appear fondly to imagine that there is some virtue in providing 500 or 600-ohm links to the speaker, irrespective of physical distance. This is not the case.

Such a system involves at least one extra output transformer and its consequent losses. Its use is not justified — let alone its cost—unless the losses are going to be less than those incurred by extended voice coil leads. This is unlikely, in the average domestic situation, especially for 15-ohm circuits.

TAPE EDITING

Getting back briefly to the subject of tape editing, &c., I made a few suggestions in the June issue, culminating in the idea of an electronic fader which would permit signals on a tape to be attenuated or faded out completely during the cutting and editing process.

Apparently others have had the same idea, because there are reports from overseas of recorders which allow a commentary to be superimposed over previously recorded matter, without completely obliterating it. I should imagine that the same facility could be employed to do the other things I suggested.

By way of conclusion, we reprint a letter from a reader interested in the subject of interference from fluorescent lights. It should be of interest to those who are victims of the trouble:

Dear Sir,

In the questions and answers column of this month's issue, I note a correspondent's query about fluorescent tube interference. A very complete article on this subject appeared in the March 1950 issue of "Wireless World". It appears that all the units used for the Radio Exhibition in England had to be "suppressed", where it can be imagined, any interference at all would cause exhibitors some considerable trouble. A circuit was given and I have copied it on a separate paper in case you cannot easily obtain it.—C. McC. (Dunedin, NZ).

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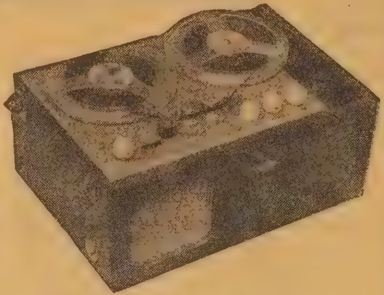

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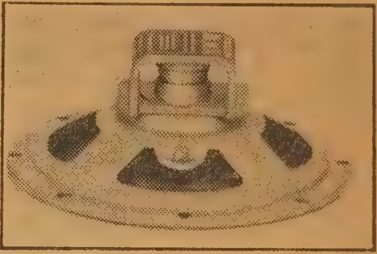
TWO NEW ROLA LOUDSPEAKERS

Two new loudspeakers are announced by the Rola Company of Richmond, Victoria, both in the 5-inch field. Three types of output transformer are also available which may be attached to the speakers as required.



The model 5B speaker. The more sensitive 5F type has a larger magnet structure.

MODEL 5B is a 2½-watt job with a resonance of 150 cps, designed for peak performance at low cost. It replaced the well-known 5C, and has a centre-block magnet, a higher acoustic efficiency and a depth of only 1 15/16 in from pad ring to rear. When used with the standard L transformer strapped to the side, there is no addition to any of the vital speaker dimensions. The L transformer is an open type, but the enclosed Isocore type G can also be used if mounted.

The open type transformer.

The main use for the 5B is with mantel receivers where there is reasonable output and a need for the smallest possible size.

Model 5F is a ring magnet speaker a little larger than the 5B, but with a higher acoustic efficiency due to its higher flux density. It has approximately twice the output of the old 5C, and is primarily intended for battery receivers.

This speaker may be fitted with either the L or G Isocore transformers, but the latter is recommended.

Either type transformer may be mounted on the speaker housing, which has an overall depth from pad-ring to rear of 2¼in. It weighs 10¾ oz.

The three output transformers include type GCB91, a battery valve transformer designed for the 1S4 and 3S4, type LDG68 for the 6V6, 6AQ5, 6BW6 and 25A1, and the LCG72 for the 6BV7, and all other 7000 ohms impedance AC valves. (Trade Review).

FROM THE SERVICEMAN WHO TELLS

As I have mentioned on previous occasions, a serviceman needs to be a versatile type of individual. He will be called upon to deal with many phases of the electronic art, from telephones to talkie plants; blackout systems to burglar alarms. At the moment it is the last named device about which I wish to write.

IDEALLY, I suppose, the serviceman should not be encouraged to venture too far outside the boundaries of what is clearly his own job, that of repairing faulty radio sets, and should leave the specialised jobs to those whose years of experience in a particular field make them better equipped to deal with problems peculiar to it.

However, it doesn't always work out that way, and one must be prepared to be confronted with a fair percentage of jobs away from normal routine. Since such jobs frequently entail starting from "scratch" with only a general idea of the principles involved, one must usually devote some time to initial research before coming to grips with the problem.

For this reason such undertakings may not always be an outstanding financial success, though there are compensating features. Personally, while I don't go searching for jobs of this kind, I am usually content if I "break even". The experience is often valuable, while the prestige which one gains by being ready—and able—to tackle something out of the ordinary is one of the best advertisements one can get.

Thus it was that, when a business associate—and a very good friend—asked me to check the burglar alarm system at his shop, I readily agreed, even though my knowledge of such systems was limited to "book learning".

PROFESSIONAL JOB

A point which must be emphasised at this stage is that the installation was not an amateur one. It had not been installed by an electrician or radio serviceman doing such jobs as a sideline, but by someone who specialised in burglar alarms and nothing else. In view of this fact, the discoveries I made later are all the more surprising.

So, before tackling the job I tried to remember all the things I had ever read about burglar alarm circuits and did a little quick research to bring myself as up to date as possible. A brief resume of available data on the subject should be interesting as well as helping to condition the reader for my description of a commercial installation.

There are apparently three general classifications for burglar alarm systems: The open circuit system; the closed circuit system; and the balanced system.

The closed circuit system is the simplest of the three, and is really only an elaboration of the ordinary front door bell circuit. It consists of a bell, batteries, and a set of contacts on each door and window, plus, of course, the necessary wiring to connect all these items together.

All the contacts are wired in parallel and are so designed that they are held open while ever the door or window is shut, but close immediately either is opened only a few inches. It is also normal to provide some additional circuitry whereby a local circuit is closed immediately the bell is energised, thus causing the bell to continue ringing, even if the door is closed again.

In some cases special bells are designed to provide this feature, having an additional set of contacts which are operated by the bell armature, and which are connected in parallel with the door contacts. Another method, more frequently used nowadays, as far as I can gather, is to use a relay to close the local circuit and provide the "continuous ringing" feature.

CONTACT TROUBLE

If properly designed and installed, such a system can be reasonably satisfactory, though it has a number of fundamental weaknesses. One of these is the fact that the alarm depends for its operation on the closing of a door or window contact and that, unless very carefully designed, there is always the possibility that the contacts will fail at the very time they are required.

There are many reasons why such contacts should fail, but their main enemies are dust, corrosion, and loss of tension in any springs employed. For this reason, and remembering that there will normally be very little maintenance of the system, it is essential that such contacts be properly designed.

Attention must be given to preventing corrosion of the contacting surfaces, the automatic cleaning of the contacts every time they operate, and the use of springs which have been properly tempered and thus able to retain their characteristics indefinitely.

Another weak point about the open circuit system is that it can be rendered inoperative by cutting the wires to a particular set of contacts. For this reason such systems need to be carefully wired so that both the contacts and wiring are fully protected against tampering.

CLOSED CIRCUIT

On the other hand, the "closed circuit" system has been developed to minimise these problems and so provide a greater degree of reliability.

In this system, all the door and window contacts are wired in series and designed so that they are normally closed when the windows and doors are closed. The circuit is completed through a relay and battery and, when all contacts are closed, the relay holds open a set of contacts in the main bell circuit. With the main switch to the bell closed, the system is "ready to go".

Anything which happens to open the relay circuit, such as the opening of a door or window or the cutting of wires to the contacts, will cause the relay to drop out and close the bell circuit. The relay is usually designed so that it will not pick up again and must be manually reset. This provides the continuous ringing feature.

It is fairly obvious that there is not much chance of such a system fail-

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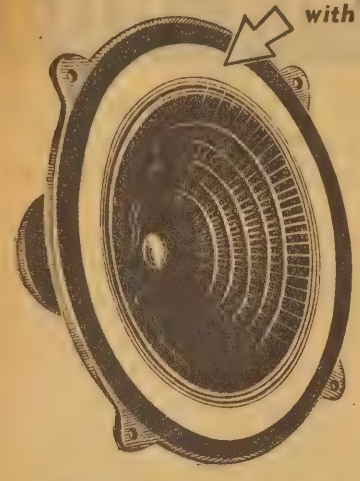

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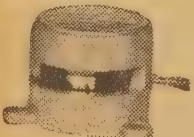

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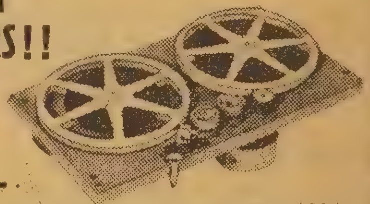

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ing to operate, since the opening of a circuit is a far more definite operation than that of closing it, the only disadvantage being a tendency to false alarms if the contacts are poorly designed. There is also the point that there is a small drain on the batteries while the system is set up, requiring more frequent replacement.

Nevertheless, this system is generally regarded as far more satisfactory than the older open circuit system and is most generally employed.

The "balanced" system is one in which the alarm will operate if the contacts are either opened or short-circuited and is obviously intended to foil the "intelligent" cracksman. As far as I can discover, its complexity tends to outweigh its advantages, except in special cases, and it is seldom used.

FIRST IMPRESSION

This then was more or less my general knowledge of the subject when I commenced to delve into the mysteries of my friend's installation. In view of all that I had read and heard, I expected nothing less than a closed circuit system and, since it was a commercial installation, that the quality of components would be above reproach.

My first surprise came when I commenced checking the circuit and discovered that it was of the older open circuit variety, with a relay to keep the bell ringing once started. This, though surprising, was not, in itself, worthy of much comment. But viewed in the light of subsequent discoveries, it assumed considerable importance.

What was worthy of comment was the quality of the relay. It looked a pretty shoddy attempt at relay construction. The design did not follow the conventional relay pattern, but was more reminiscent of the cheap single-coil buzzers which were at one time available in chain stores, composed mainly of a pressed steel base and a few pieces of fibre insulation.

The device consisted of a single coil mounted horizontally on a pressed steel base and an armature consisting of a strip of (supposedly) spring copper, with an iron slug at one end.

DIFFICULT ADJUSTMENT

A set of contacts, similar to those used in a buzzer, were designed to close when the armature was attracted to the coil. As I found it, it was completely inoperative, the gap between the armature and the coil being far too great to allow the armature to be attracted.

There were no means of adjusting this gap, other than by bending the metal strip. This might have not been so bad had there been any spring in the metal, but, as it was, it could be quite easily bent with the fingers. To make matters worse, the gap was rather critical and I spent some time adjusting the setting before it would operate correctly. Even when I did succeed in getting it just right I had no confidence that it would remain that way for long.

Next, I turned my attention to the original complaint which the owner had mentioned, namely, the straight-out failure of the alarm to operate when the doors were opened. Now that I had some knowledge of the circuit I had a fair idea that the trouble would be in the various door and window contacts, but I must confess that I was not prepared for what I found.

The first one I tackled was a door contact. The whole assembly was mounted on a strip of brass recessed into the door frame just below the top hinge. The assembly was mounted flush with the wood except for a small pin protruding through the plate from the contacts on the rear. Thus, when the door was closed, the pin was forced in flush with the plate, holding the contacts open, but allowing them to spring closed as soon as the door was opened.

All this was apparent at a quick glance and seemed to be a perfectly normal and satisfactory arrangement—until I unscrewed the plate and examined the back of the thing. Not only was it immediately apparent why the contacts had failed to operate but also a source of wonder that they had continued to work for so long.

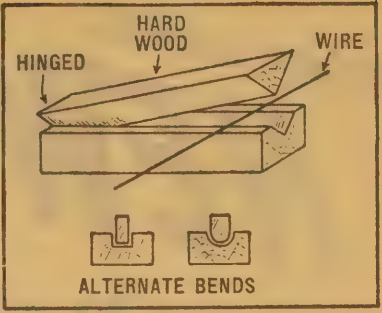
The actual contact was made between two pieces of brass; one a short length mounted at one end of the plate and forming a fixed contact, and the other being about 2½in long, anchored to the other end of the plate on insulating strips, and forming the moving contact. The pin was attached to this strip near the free end.

POOR CONTACT

The two pieces of brass overlapped by about ¼in to form the contact area, but no attempt had been made to fit proper contacts, such as might be found in a relay or similar device. Nor was the brass protected by any form of plating to prevent tarnishing, with the result that time had changed the bright metal surface to a dull grimy appearance which was ficient contact.

This was bad enough, but it was made worse by the inefficient nature of the spring contact. As in the case of the relay it was no doubt supposed to be spring brass but, in fact, there was little or no sign of any spring in the metal. On the contrary, it was

A WIRE BENDER



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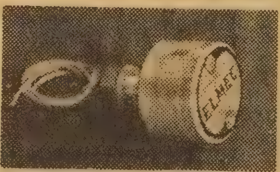

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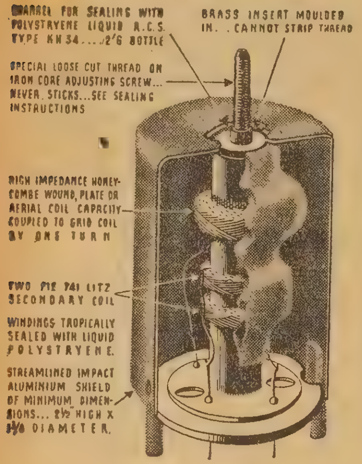
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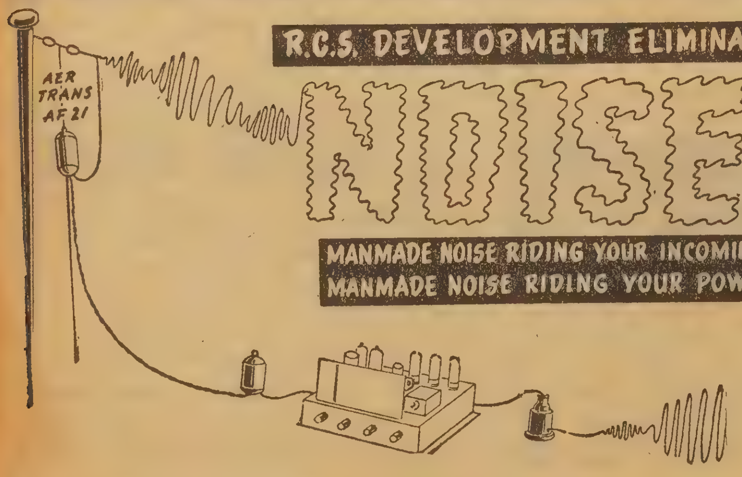
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so soft that, even after it had been bent so as to bear against the other contact with considerable pressure, it failed to return to this position after the door had been closed two or three times.

Eventually, by reducing the movement required to open and close the circuit to a bare minimum, I was able to make the thing work consistently, though I still had the impression that the adjustment could not possibly last for more than a few weeks.

A second set of door contacts was in much the same condition, though for some strange reason the spring brass did appear to be more nearly the true variety.

MORE TROUBLE

At this stage I blissfully imagined that I had "seen eveything", but the real surprise, the window contacts, was yet to come. The window was a box frame type and, because of the large area to be protected and the fact there were two windows, protection was provided by a system of four fine steel wires stretched from the top to the bottom of the window frame. Spaced about eight inches apart, they made it impossible for anyone to get in the window without disturbing them.

In this respect the scheme was quite sound because a set of contacts at the top of each wire was so arranged that the circuit would be closed whether the wires were either pushed aside or cut. At least, that was what was supposed to happen. What really did happen was that I was unable to make any of the four contacts operate the alarm, which was not surprising when I came to examine them more closely.

Each consisted of a horizontal brass finger, pivoted in the centre, and to one end of which was attached the steel protecting wire. Above and below the other end of the finger was a contact, so that it could only move a short distance in each direction before it touched one of them. A small coiled spring attached to finger exerted tension against the steel wire to ensure that the circuit would be closed when the wire was cut.

So far everything was fairly straightforward and a reasonably satisfactory approach to the problem, at least from a mechanical point of view. The real trouble was in the electrical side which, in my opinion, showed a complete lack of understanding of even the fundamental principles of practical contacts.

FRICTION CONTACT

Connection to the brass finger was made through the screw on which it pivoted and was of doubtful efficiency because it was necessary to allow a certain slackness in the mounting to ensure smooth mechanical operation. The next potential trouble spot was the contacts themselves. These were small brass pillars against which the central finger would press when it was moved in either direction.

Like the door contacts, neither the finger nor pillars had been plated so that the once-bright brass surface was now blackened by tarnish. Since no attempt had been made to provide a wiping or self cleaning action for the contacts their failure was not surprising.

There was also some doubt as to the effectiveness of the connection to the pillars from the other side of the circuit. The pillars were actually short lengths of brass tubing mounted on the wooden base by means of steel screws. As far as I could determine, connection was made through the steel screw to the brass tubing and the effects of rust on the screws was now quite advanced.

And finally, to cap it all, there was the connection to the contact block itself. Two solder lugs were fitted to the side of the block to provide connection to the rest of the circuit. Imagine my feelings when I discovered that the wires had been simply pushed through the holes in the solder lugs and twisted, with no attempt at a soldered connection. Nor was the lack of solder an isolated case, for every lug was the same, with no sign of a soldering iron ever having been near them.

CONTACT REQUIREMENTS

I must admit that the above discoveries staggered me somewhat. I am quite prepared to admit there are doubtless many fine points about contacts which I have yet to learn and that in the eyes of an expert I would be regarded as a "mug" at the game. For all that, I consider that I should give the game away if I could not design a better system of contacts.

Such matters as the choice of noncorrosive surfaces for the actual contacts, either by using a suitable metal or by plating the metal chosen; the design of the contacts to be "self cleaning" wherever possible; the elimination of what may be termed "friction" connections wherever possible; the use of high quality spring metal; the soldering of joints — all these things one would imagine to be simple fundamentals which any designer would observe as a matter of course.

Anyhow, by careful cleaning of the various contacts I was able to put the system back into operating condition for the time being, but I conveyed my findings to the owner and advised him that the installation as it stood was only producing a false sense of security and that some drastic alterations were needed. We discussed the matter at some length and it was finally decided that the contacts should be replaced with commercial micro-switches, plus a better type relay for the continuous ringing circuit.

I suggested changing the system to a closed circuit type, but the owner was not very keen on this arrangement, having heard that the persons involved had abandoned this system in favor of the open circuit type due to the large number of false alarms which they caused. Considering the type of contacts they used it is little wonder!

FINAL DECISION

Since his technical knowledge was limited I did not press the point, feeling that the existing circuit would be reasonably reliable once satisfactory contacts had been fitted. So there, for the moment, the matter rests. The micro-switches and other components are on order and I am all set to spend a Saturday afternoon installing them as soon as they arrive.

In the meantime I can't help wondering how many other people are depending on similar systems for the protection of valuable property.

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A SURVEY OF RADAR TECHNIQUES

PART 4—THE RADAR RECEIVER

This is the fourth in the series of articles dealing with the special components of microwave radar equipment. It discusses the receiving portion of the generalised radar set—especially the microwave parts such as the crystal mixer and the klystron local oscillator. The other components are covered in less detail since they have been discussed here previously or are standard practices in fields other than radar.

THE function of the radar receiver is to detect the very weak echo signals returned by the target and to amplify them greatly so that they can be visibly displayed on the screen of an oscilloscope to convey information regarding the range and azimuth of the target.

As was indicated by the "radar equation" given in Part 1, the range of a radar system is inversely proportional to the fourth root of the minimum signal which the receiver will detect.

NOISE FIGURE

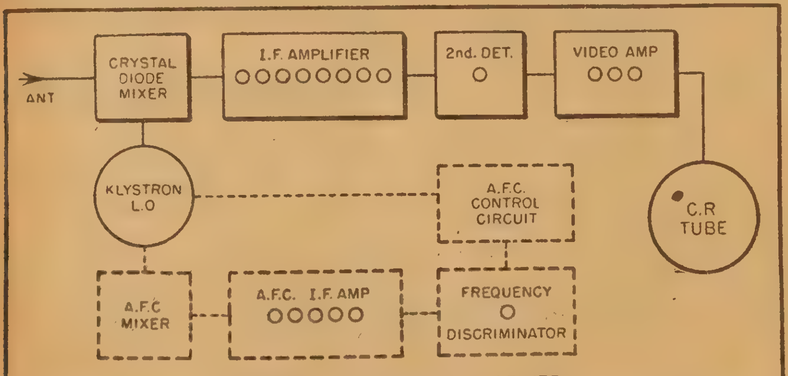
The minimum detectable signal is determined by the noise figure of the receiver, so that any improvement in the receiver noise characteristics results in improved range.

Since a three decibel improvement in the receiver sensitivity would have the same effect on set performance as doubling the transmitter power, and at considerably less expense and power consumption, much effort has been expended toward this end.

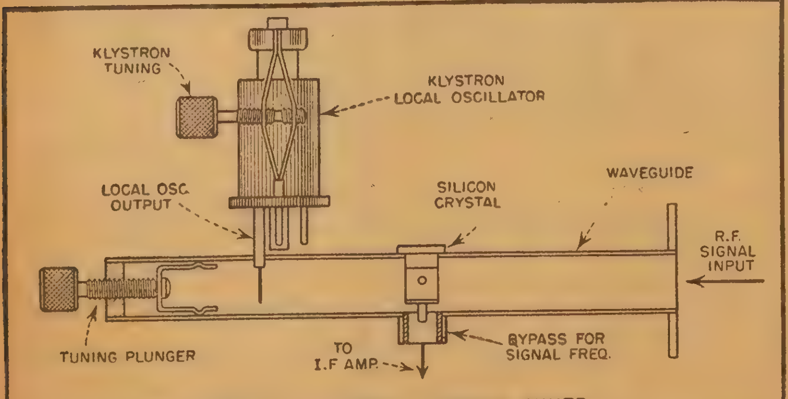
It is probable that added range can be obtained more economically by receiver improvements than elsewhere in the radar system, with the possible exception of the antenna. And, since typical radar receivers exhibit noise figures about 13 to 50 times greater than that of a theoretically perfect receiver, there is still sufficient room for improvement.

For reasons of greater sensitivity and selectivity, the superheterodyne type of receiver is used almost universally in modern radar practice. A block diagram of its component parts is given in Fig. 1.

The input stage is usually the mixer, or frequency converter, in which the echo signal from the target is heterodyned with the local oscillator signal to produce a different frequency, which is amplified by the IF amplifier.



CONVENTIONAL RADAR RECEIVER
FIG. 1



TYPICAL WAVEGUIDE CRYSTAL MIXER
FIG. 2

The output of the IF amplifier is rectified by a second detector and fed into a video amplifier and thence to the cathode-ray viewing tube.

For microwave radar, the mixer is usually a silicon crystal diode. An RF amplifier is seldom employed, since microwave amplifier tubes having sufficiently low noise figures do not exist in practical form at present.

The crystal mixer, on the other hand, has good noise and transit time characteristics and permits the signal to be converted immediately to a lower frequency, where the state of the art affords low-noise amplification.

The most serious disadvantage in the use of the crystal mixer lies in its susceptibility to accidental burn-out by the high-power transmitter pulses. It is the function of the "duplexing system", to be described in the next issue of this series, to protect the crystal from such burn-out while the transmitter is operating.

Details of a typical crystal mixer are shown in Fig. 2. The silicon semiconductor diode is mounted in a socket across the waveguide into which is coupled the RF signal and the local oscillator signal. The amount of local oscillator injection is regulated by a tuning element such as tuning screws or a plunger.

DIFFERENCE FREQUENCY

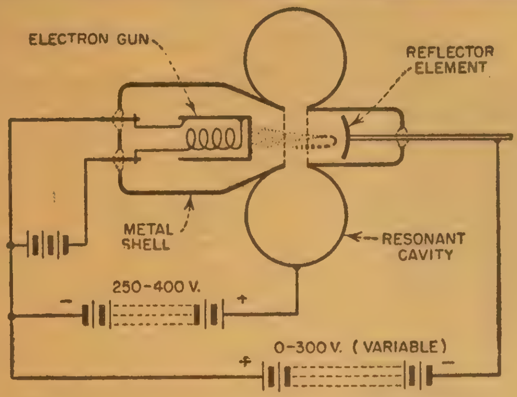
The IF difference signal is taken out at one end of the crystal by a coaxial coupler, which is by-passed for the signal frequency, but not for the lower intermediate frequency. The conversion loss of the crystal mixer circuit may be as much as 10db. This loss is easily made up in the IF amplifier stages, however.

The local oscillator, or "beating oscillator", as it is sometimes called, must be a stable, continuous-wave signal source which will tune over the range of frequencies covered by the radar set. It is usually the only vacuum tube in the receiver which operates at a microwave frequency.

Although triode oscillators of the "lighthouse" type have been used in some cases up to about 3000 megacycles, the klystron or velocity modulation tube is more universally employed.

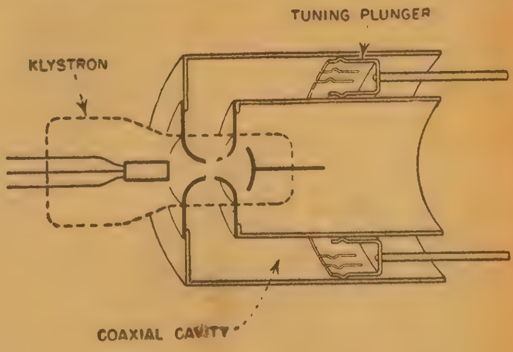
The klystron oscillator is a special form of microwave vacuum tube which, like the magnetron, was developed largely during World War II for use in radar.

The kind most commonly used for



ESSENTIALS OF REFLEX KLYSTRON TUBE

FIG. 3



USE OF EXTERNAL COAXIAL CAVITY WITH KLYSTRON FOR WIDE TUNING

FIG. 4

receiver local oscillators is the reflex klystron illustrated in Fig. 3. In this tube- a thin beam of electrons, like that in a cathode-ray tube, is projected from an electron gun through two apertures in a cavity resonator.

If oscillations are assumed to exist within this resonant circuit, and the RF electric field associated with this oscillation is concentrated between the apertures, some of the electrons passing through the cavity will be slowed down while others will be accelerated.

This process is known as velocity modulation. It occurs because some of the electrons traverse the gap while the RF field adds to the DC accelerating potential applied between the cathode and the cavity, while others cross while the RF field is retarding.

ELECTRONS BUNCH

The net result of this is that the slow electrons are overtaken by the fast ones at some finite distance beyond the cavity, so that dense packets or "bunches" are formed.

In the reflex klystron, a reflector, or repeller electrode is used to turn the bunched electron beam around and send it back through the cavity. By adjusting the negative DC potential on this reflector, the distance the electrons travel between the cavity and the reflector form just as they are traversing the gap in the RF cavity for the second time.

If these bunches of electrons, which are spaced the period of one RF cycle apart, are timed to cross the gap while the RF field there is retarding, they will be slowed down and some of their kinetic energy will be converted into RF energy to reinforce the oscillation.

As in the magnetron, or any other oscillator, the original oscillation may be initiated by a noise voltage or other random fluctuation.

EFFICIENCY LOW

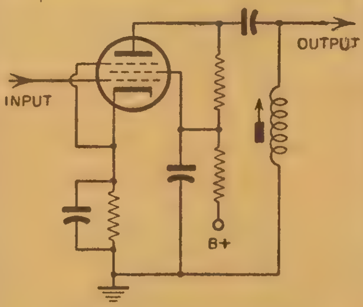
The reflex klystron is characterised by relatively low efficiency (½ to about 2 pc) but also by ease of tuning and simplicity. Although only a few milliwatts of power must be supplied to the crystal mixer for efficient conversion, most klystron oscillators are designed to deliver many times that much so that the oscillator may be loosely coupled to the mixer. This is done to improve the operating stability of the oscillator.

Also in connection with frequency stability, the DC voltages applied to the cavity and repeller of a reflex klystron as shown in Fig. 3 must be well regulated.

An electronically regulated power supply is usually employed, although in some cases simple VR tube regulation will suffice.

Mechanical tuning is usually accomplished in the reflex velocity modulation tubes by deforming one or both walls of the cavity resonator in a manner such that the gap spacing, and hence the capacity of the resonant circuit, is varied.

In other types, the resonant cavity is not an integral part of the klystron tube but is clamped around so as to make good electrical contact to disc seals which connect t the internal gap.



TYPICAL SINGLE-TUNED RADAR I.F. AMPLIFIER STAGE

FIG. 6

Tubes of the "external cavity type are usually tunable ove greater frequency ranges than "ir tegral cavity" tubes, especially whe the external tuner is a coaxial typ like that illustrated in Fig. 4.

Tubes exist which will tune ove a 2.1 range of frequencies in circuit of this type in contrast wit a maximum of about 20 pc tunin for the integral cavity types. T maintain oscillation, the reflecto voltage must be changed with th tuning on all reflex klystron types.

Another feature of velocity modulation reflex tubes which is important in radar applications is electronic tuning. The operating frequency of most reflex klystron may be varied as much as 1 pc b changing the repeller voltage slightl about the value which gives maximum power output.

The electronic tuning and powe output characteristics of a typica 10,000 megacycle reflex klystror plotted versus repeller voltage, ar shown in Fig. 5.

CRITICAL VOLTAGES

Note that the tube oscillates at several discrete values of repeller voltage. These are called "repelle modes". They correspond to different repeller voltages at whicl

(Continued on Page 94)

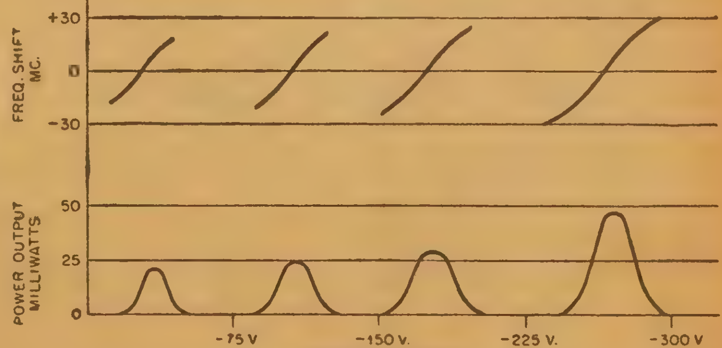
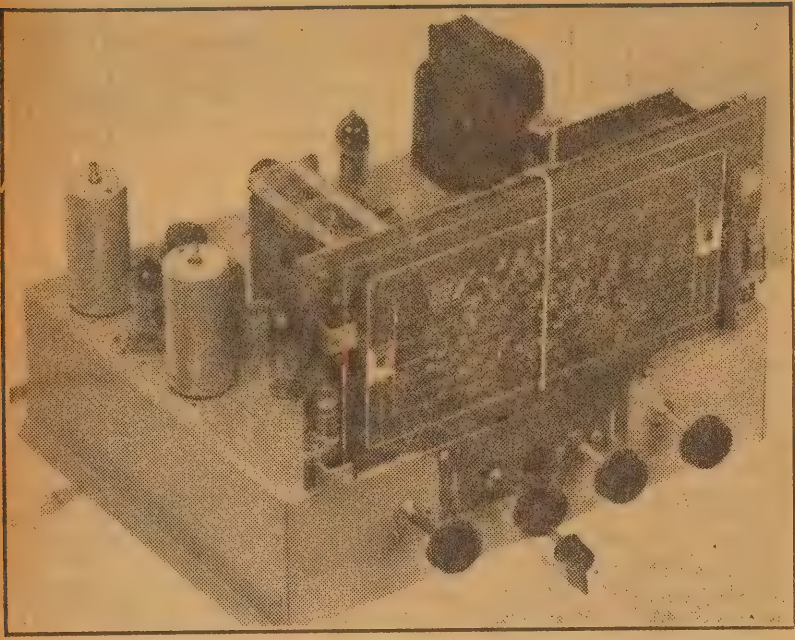


FIG. 5

A MULTI-BAND DX RECEIVER

Here is a large set for those who simply must have good sensitivity and multi-band facilities as the main features. Designed for the listener in the country or other areas where effective broadcast band coverage is not generally consistent, this set can provide entertainment from the world. It includes a noise limiter stage and has terminals and switch for a crystal pick-up.

by Raymond Howe



Here is the completed set before being fitted into a cabinet. The controls are from the left—Volume, Wave-change switch, Tuning, Tone with the Radio/Pick-up switch at the lower centre. This switch also switches the noise-limiter stage. If the chassis is fitted into the cabinet in the initial stages, the control shafts can be cut to the desired length before the set is wired.

WE have, of late, been devoting a good deal of attention to wide-band receivers for city, suburban and well-populated country areas. Our latest tuner in this series was capable also of "normal" reception with the usual proportion of gain and selectivity.

However, the reader in "difficult" areas is forced to abandon any ideas of wide-range reception and to concentrate simply on obtaining reasonable entertainment from any available source. We have received consistent demands for a set to fill such a role.

What is required is a dual-wave or multi-band set with: (1) An RF stage for good sensitivity on all bands and improved image rejection on the short waves; (2) Some facility to lessen the severity of bursts of "static" or man-made electrical interference; (3) Provision for a pick-up and (4) about 3 to 4 watts of audio power.

We have described such sets in years past but we are now taking the opportunity to present a new set employing a multi-band coil unit now available on the market. With this unit, this set will tune the broadcast band, the 40 to 110 and the 13 to 42 metre short wave bands.

On the broadcast band, the added sensitivity of the RF stage will normally allow reception of distant stations even during the day. On those occasions when otherwise good reception would be marred by "static", a flick of a switch will bring the noise-limiter stage into operation to "iron out" the bursts of interference and give tolerable listening, even in bad conditions.

Alternatively, one can simply turn the wave-change switch to one of the short wave bands and tune in one of the Australian short wave programs especially presented for the country listener. Apart from general light entertainment, such items as news broadcasts, market reports, sporting broadcasts are handled in this way.

One will find almost invariably that, when conditions are not very pleasant on the broadcast band, resort to the short wave bands will produce relatively noise-free reception of an appropriate program.

As an alternative to radio entertainment, the pick-up facility may be used for standard 78 or long-playing recordings for a quiet evening's relaxation or a not-so-quiet party. All in all, this set can be the focal point for all home entertainment.

To provide all these facilities in a straightforward manner involves a minimum number of 7 valves, one of these being the rectifier. We have used the miniature 9-pin valves in all except the rectifier and noise-limiter stages.

CIRCUIT DETAIL

Treating the circuit in detail, we have used for the first time the 9-pin 6BH5 variable-mu RF valve. It has much the same characteristics as the pentode portion of the familiar 6N8. We have earthed the cathode, biased the valve through the AVC line from the back-bias resistor and tied the screen to the IF valve screen. Both are supplied through a common dropping resistor from the HT line.

The 9-pin 6AN7 is used in the converter stage. It has characteristics similar to the 6AE8 in the miniature series and the X61M and the ECH35 in the larger octal-based types. As a matter of fact, apart from the slightly different pin connections, the 6AE8 could be used in place of the 6AN7 without circuit change, although the oscillator grid resistor could well be reduced from .05 megohm to .03 megohm.

The cathode of the converter also is earthed and the grid biased via the AVC line. The screen and the oscillator anode are fed through a common dropping resistor, a single .025 megohm 2-watt size or two .05 megohm 1 watt connected in parallel.

Note that for the sake of clarity in the circuit diagram, the wiring of the coil switching is not shown. The appropriate connections to a coil unit are usually supplied with it. Those minor components which may already be wired into the coil unit are marked with an asterisk.

The 6N8 is the logical valve for the IF stage. As with the two preceding stages, the cathode is earthed and the grid biased through the AVC line. This procedure is rather convenient in that it saves six components for the price of one ½ watt back-bias resistor and also gives more space around the sockets for other components. A slight modification may be required in units where the S/W RF coils return direct to chassis.

The screens of the first three stages operate at 85 to 90 volts at the "no signal" condition with a bias of just over 2 volts.

The two diode anodes in the 6N8 are tied together and are driven from the 6N8 anode to provide a negative voltage across the 1 megohm diode load resistance as the AVC voltage. The standing bias of about 2 volts already mentioned is obtained by returning the earthy end of the 1 megohm diode load to the back-bias resistor connected between the power transformer secondary winding centre-tap and chassis.

NOISE LIMITER

The 6H6GT noise limiter circuit has been used in many R. and H. designs in the past and has been found particularly advantageous for clipping the peaks off electrical interference voltages amplified along with the desired signal. It automatically adjusts the clipping level according to the strength of signal.

It will also tend to clip peaks of modulation on heavily modulated signals but modulation depth of this order is not normally encountered with broadcast stations.

The output from the noise-limiter stage is taken to the 3-position function switch which feeds either radio program or the output from the pick-up into the 6N8 first audio stage. This is a conventional pentode arrangement resistance - capacitance coupled to the 6M5 power output stage. The diode anodes contained in the same envelope are not required and are simply tied to the cathode.

The 6M5 carries a simple "treble cut" tone control in the grid circuit. The 5000 ohm resistor at the grid acts as a stopping resistor to prevent parasitic oscillation.

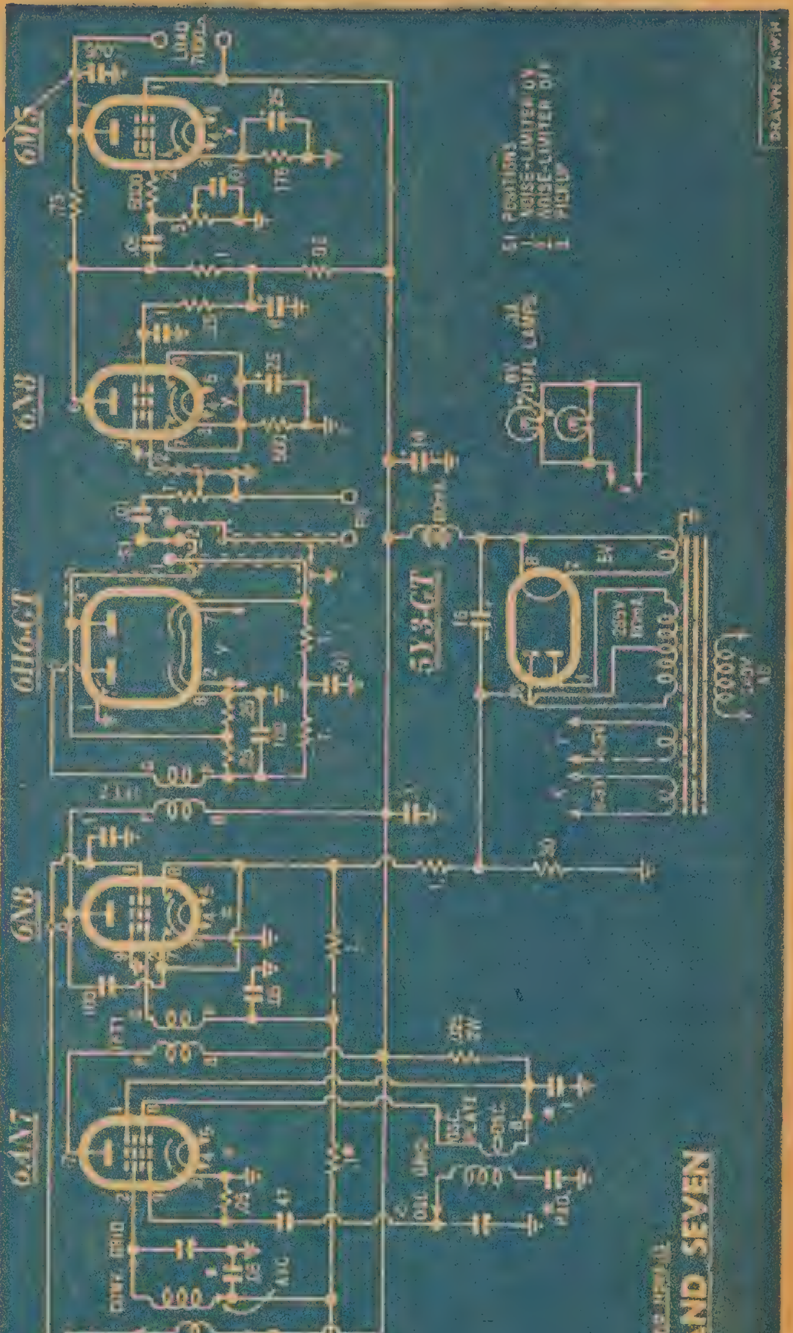
An optimum amount of negative feedback is introduced in the output stage by the .75 megohm resistor from anode to anode of the two audio valves. There is adequate audio gain to allow for this and it has the advantage of improving the audio characteristics of the output transformer.

OUTPUT LEADS

The capacitor from the 6M5 anode to chassis is a precautionary measure against lengthy leads to the output transformer introducing instability in the 6M5. The output transformer will normally be mounted on the speaker, the connections to the 6M5 anode and the HT line being made through the miniature 4-pin plug and socket mounted at the rear of the chassis.

If you want to go for a higher quality output transformer, it could be mounted on the chassis in place of the filter choke and the choke fitted under the chassis against one side.

The power supply employs a 285 volt, 80 mA transformer feeding into a 5Y3GT rectifier. The current drain of the set is just on 70 mA and so a 75 mA or 80 mA filter choke will provide sufficient filtering with a 16 mfd capacitor on either side of it. Note that the first 16 mfd filter capacitor returns to the centre-tap of the transformer, not to chassis.



The coil connections in the RF and converter stages are marked to conform with the lead identification supplied with a commercial coil unit by the manufacturer. The components marked with an asterisk may be included within the coil unit by the manufacturer. Note that the s/w RF grid coils in some units may have to be returned to the AVC line instead of to earth.

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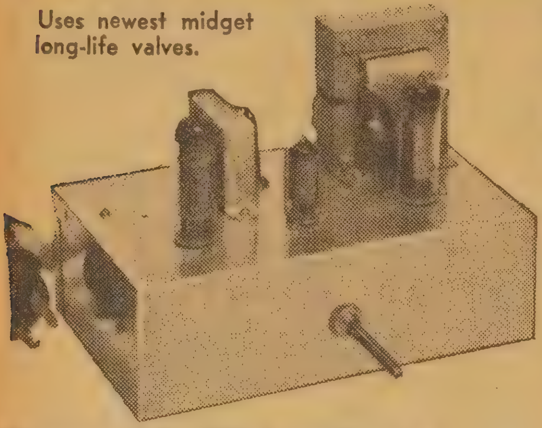

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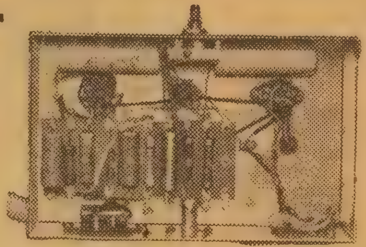

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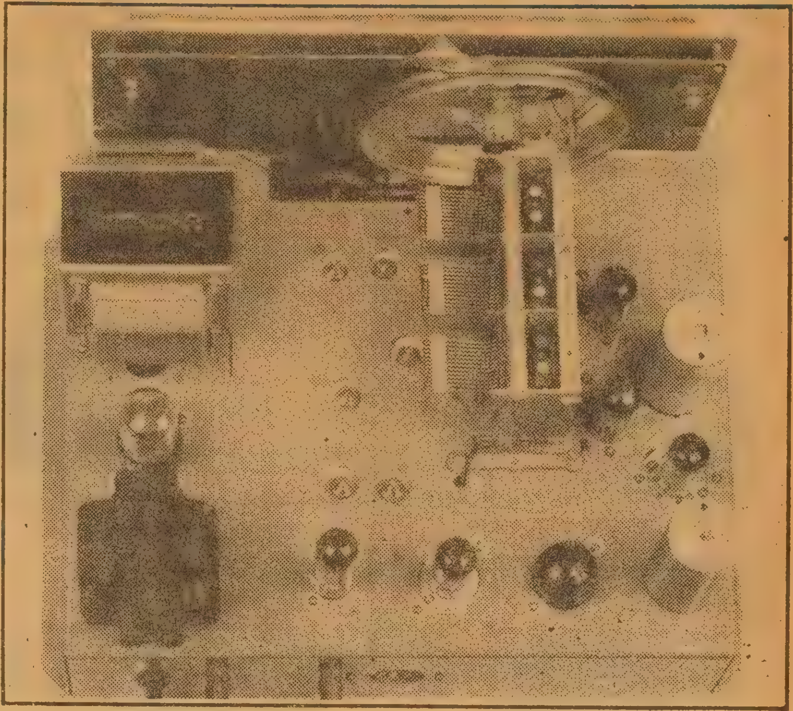
TWO VIEWS OF THE RECEIVER



To the right of the gang is the 6BH5 with the 6AN7 behind it whilst from the upper right around the edge of the chassis are IFT 1, 6N8 (IF), IFT 2, 6H6, 6N8 (audio), 6M5. The power transformer, 5Y3GT and filter choke are at the left.

Coming to the actual job of construction, the commercial coil unit does take care of a certain amount of the wiring for you. For the remainder of the circuit wiring, there is ample room for fitting the components into their place.

The chassis dimensions are fixed largely by the coil unit and dial. However, a ready-made chassis should be available, at least on order, by the time you read this article.

We suggest as the first step that you fit the power transformer and filter choke. Following on this, it is easier to fit the valve sockets together with the output socket and terminals at the rear.

A logical orientation of the valve sockets leads to easier wiring and, as a guide, we suggest following arrangement. Mount the 6BH5 socket with the gap between pins 1 and 9 toward the IFT 1 hole, the 6AN7 socket with the gap toward the 6N8 (IF) hole, the 6N8 (IF) socket with the gap toward the adjacent side of the chassis, the 6H6 (GT) socket with the keyway toward the coil unit position, the 6N8 (audio) socket with the gap toward the output socket hole, the 6M5 socket with the gap toward the coil unit position, the 5Y3GT socket with the keyway toward the 6M5.

The output socket can be mounted in any position. The "live" terminals of the aerial and pick-up groups are best mounted in the appropriate holes near the chassis bend.

At this stage the two IF transformers can go into position with the "G" pin of the IFT 1 near the adjacent side of the chassis and the "G" pin of the IFT 2 toward the 6H6 (GT) socket. Make sure that you place the transformers in their correct positions, that is, with IFT 2 feeding the 6H6(GT).

TAG STRIPS

Fit a 5-tag strip under the inside bolt of the 6H6(GT) socket, a 3-tag strip under the 6N8 (audio) outside bolt and a 5-tag strip under the rear bolt of the 5Y3GT socket.

To ensure that the solder lugs make good contact with the chassis, either fit star washers under bolt heads, or nuts where applicable, or connect all lugs together with a run of light gauge tinned copper wire.

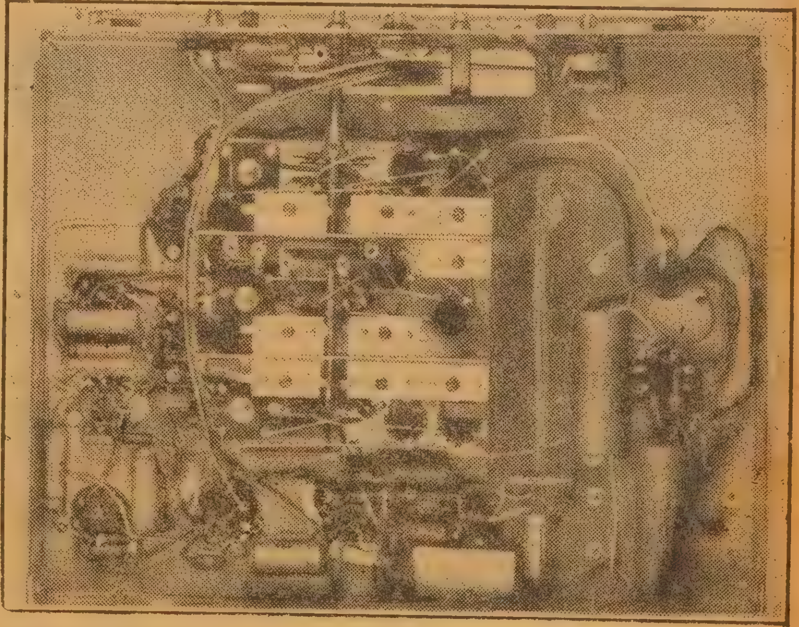
Secure the tuning gang into place before fitting the coil unit, passing the bolts through from underneath the chassis to avoid having to cut the rear ones to clear the coil unit plate.

Before fitting the coil unit, reroute the plate leads from each section so that they come out on the appropriate underneath side of the unit. As the coil unit is placed into position, pass the grid leads of each section through its respective hole in the chassis to connect to the underneath lug of each section of the gang.

At this stage, inspect the short-wave grid coil (or coils) in the RF section of the coil unit to see if its "earthy" end connects to the coil unit frame. If so, break the connection from the frame, and connect the winding (or windings in the case of a multi-band unit) to the AVC feed point on the broadcast RF coil.

The coil unit is spaced away from the chassis by the thickness of one nut. Before screwing tight the second nut on each of the four mounting bolts, see that the switch shaft of the unit aligns with the hole in the lower portion of the dial backing plate. You will need to fit an extension shaft on to the switch.

To carry the 47 pf oscillator grid capacitor, you could mount a 2-tag strip under the nut of the coil unit mounting bolt near the 6AN7 socket



This underneath view will give a good general idea of the location of most of the minor components. Use tag-mounting strips where convenient to carry "floating" junctions and to assist in anchoring components. The aerial and earth terminals are near the power cord entry with the pick-up terminals to the left.

Homecrafts PTY. LTD. ★ RADIO ★ BARGAINS

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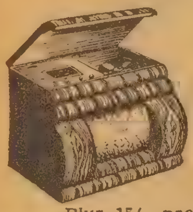

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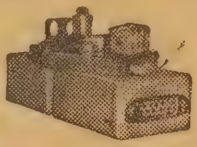

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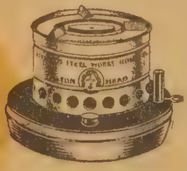

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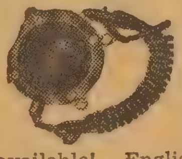

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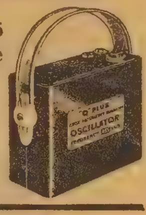

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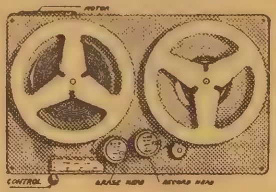

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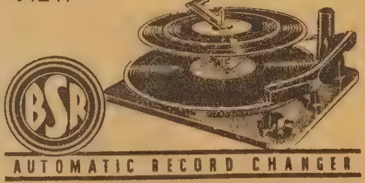

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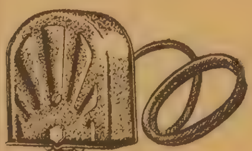

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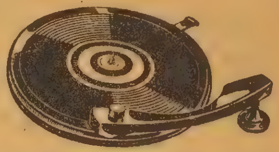

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290 LONSDALE STREET, MELBOURNE Central 4311

PARTS LIST

1 chassis 13in x 10¼in x 3½in
1 power transformer 285V a side at 80 mA, 2 6.3V 2A, 5V 2A.
1 75 or 80mA filter choke
1 3-section tuning gang
1 dial with glass to suit gang type and coil unit ranges
1 multi-band coil unit to suit converter valve
2 standard 455 Kc IF transformers, Nos. 1 and 2
1 single pole, 3-position switch
5 9-pin minature sockets, 2 octal sockets, 1 4-pin miniature plug and socket

VALVES

1 6BH5, 1 6AN7, 2 6N8, 1 6H6 (GT), 1 6M5, 1 5Y3GT

CAPACITORS

2 25 mfd 40PV miniature electrolytics, 2 16 mfd 525PV electros., 1 8 mfd 525PV electro., 3 .1 mfd 350VW, 2 .05 mfd 350VW, 2 .01 mfd, 1 .005 mfd, 2 100 pf, 1 47 pf miniature. (Those marked with an asterisk on the circuit diagram are not included here).

RESISTORS

4 1 meg. ½w., 1 1 meg. potentiometer, 1 .75 meg. 1w., 1 .5 meg. potentiometer, 1 .25 meg. 1w., 2 .25 meg. ½w., 2 .1 meg. 1w., 1 .05 meg. 1w., 1 .025 meg. 2w., 1 .02 meg. ½w., 1 5000 ohm ½w., 1 500 ohm ½w., 1 175 ½ or 1w., 1 30 ohm ½ or 1w.

SUNDRIES

4 terminals (2 red, 2 black), 4 standard knobs, 1 "trailer" knob, 2 5-tag, 1 3-tag and 2 2-tag mounting strips, 1 ⅜in and 1 ½in i.d. rubber grommets, power flex and 3-pin plug, 2 yds shielded hook-up, 2 6V dial lamps, hook-up wire, tinned copper wire, solder lugs, nuts, bolts.

or screw a threaded mounting pillar on to the 6AN7 socket bolt near pin 8.

The final step is to fit the remaining controls and the dial. Note that the noise-limiter/pick-up switch is a single-pole, 3-position type having a cut-away switch wafer. This allows it to be mounted very close to the lower edge of the chassis.

The dial drive drum should be released from the dial backing plate and "floated" on to the tuning gang spindle as the dial is fitted into position. Two bolts hold the dial plate to the chassis front edge. Under the one near the volume control, a 2-tag mounting strip is secured to carry one side of the .01 mfd audio coupling capacitor.

DIAL POSITION

If you already have a cabinet for the set, it would, at this stage, be easier to fit the chassis into it. Arrange the position of the set so that the dial glass just presses against the escutcheon fitted into the dial cut-out of the cabinet.

Commence the actual wiring by cutting the leads of the power transformer to length and laying them in place, taking one 6.3 volt heater winding to the 6M5 socket and extending the other around to the 6BH5 socket past the front of the coil unit. Hold this heater run in place with a couple of solder lugs under the front mounting bolts of the unit.

The transformer primary winding makes connection with the power flex at two insulated lugs of the tag strip near the 5Y3GT socket. The green-colored earth wire of the 3-core power flex connects to the earth lug of this strip. The junctions of the filter choke and the two 16 mfd electroyltics are made at the remaining two lugs of the tag strip.

Now lay in the heater runs and earth the centre spigot of the 9-pin sockets and all socket pins indicated in the diagram. The 6M5, the 6N8 (audio) and the 6H6 (GT) are fed from one heater winding and the remaining valves fed from the other 6.3 volt heater winding. The rectifier filament is fed from the 5 volt winding, of course.

The two 6-volt dial lamps at each side of the dial are wired in parallel and connected to the heater of the 6BH5. This complete heater circuit arrangement balances the loads on the two 6.3-volt heater winding. Earth one side of one winding at the socket of the 6BH5 and one side of the other at the 6H6 (GT) socket.

From now on the way is clear to lay in point-to-point wiring runs

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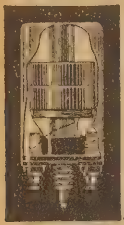
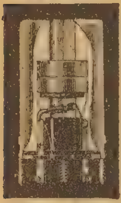
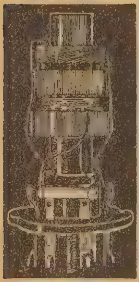


Type AC1



Type AC5



Type AC7

Type O9

Type OME

Type O1

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AC2	Ditto, Car Radio type	14 6
AC3	Second Band Pass Aerial Coil for BP2 Kit	12 11
AC4	Standard Medium gain B/C Aerial Coil	11 7
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O5	Midget Osc. Coil, to suit 6BE6/6SA7	12 11
O7	Standard Osc. Coil, to suit 6J8, 6A8, etc.	11 7
O9	Standard Osc. Coil, to suit ECH33, 35, X61M, 6AN7, 6AE8, etc.	11 7
O10	Midget 1600 Kc Osc. Coil, to suit O9 converters above	17 5
O11	Standard size Osc. Coil, to suit 1600 Kc-1900 Kc I.F.'s converters as for O9	17 5
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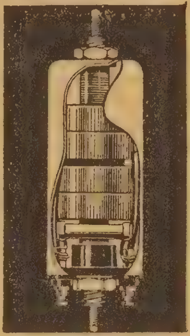
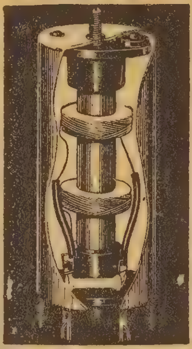
RC3	Midget RF with reaction	14 6
RC4	Standard RF coil, medium gain	11 7
RC5	Ditto, high gain	12 11
RC6	Midget Reinartz	14 6

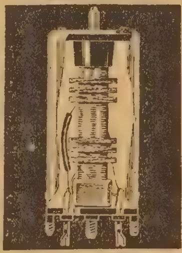


Type IF1

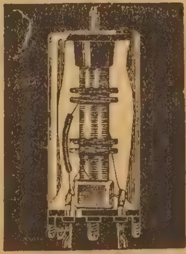


Type IF3

Type IF8



Type IF10



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and all of the minor components. The underchassis photograph will give you some idea of the logical positions for these. Use spaghetti insulating sleeving over the exposed leads of components to avoid possible shorting of connections.

There are a couple of points worthy of mention at this stage. The .1 mfd capacitor at the common connection of the 6BH5 and 6N8 screens should be placed at the 6N8 socket. We found this desirable to avoid instability. A second .1 mfd capacitor is shown dotted in the circuit diagram in case your particular layout demands additional bypassing.

POSSIBLE INSTABILITY

The 47 pf oscillator grid capacitor should preferably be of the miniature type. A large component here may, because of its position, couple into the body of the ½ watt 1 megohm AVC diode load or AVC decoupling resistor to cause instability on the higher frequency short-wave band. In any case, the end of each of these resistors connecting to the 6N8 diode anodes should be kept short.

In general, keep plate and grid leads short and close to the chassis, use resistors sizes according to the parts list, make all connections firm and watch for accidental shorting from wisps or beads of solder. The lead to the aerial terminal emerges from the left-hand side of the coil unit and is extended to reach the terminal through the power supply wiring.

Use shielded hook-up wire for the connections to and from the volume and tone controls, earthing the shielding at a number of points. The earthy end of the volume control is earthed back at the 6H6 (GT) socket through a length of ordinary hook-up wire.

When the set is finished and the initial trials are complete, make the following check on the noise-limiter stage. With the wave-change switch on any band and the aerial and earth terminals bridged, turn the volume control full on and listen for hum in the speaker.

HUM FROM LIMITER

Residual filter hum should be quite low, but if the hum level seems higher than expected, remove the earth connection from the specified heater of the 6H6 (GT) and try earthing the other side instead. Choose that side for earthing which gives the best hum reduction.

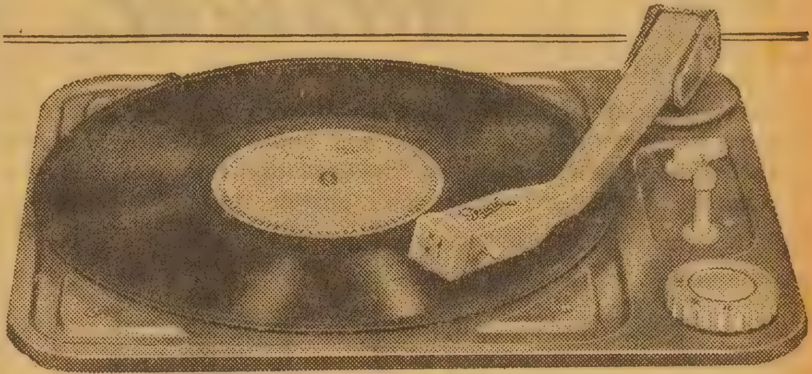
If you have more than one 6H6 (GT), pick the one which gives the best results in this respect. In some cases it may be necessary to wire a 25 or 50 ohm wirewound resistor, with variable tap, across the 6H6 (GT) heater pins, earthing the tapping and adjusting its postion for best hum reduction.

While full alignment instructions are usually enclosed with the coil unit on purchase, it must be borne in mind that the dial glass should suit the tuning gang and should carry the appropriate tuning range calibrations applicable to the coil unit.

Before commencing alignment see that the dial pointer has equal overlap on the dial glass as it moves from one extreme to the other. If you have a service oscillator on hand, "peak" the IF transformers on 455 Kc before adjusting the coil unit.

Dual

3-SPEED RECORDPLAYER-CHASSIS No. 270



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Some time ago, Tom asked me to tell him about radio valves, building up a logical story right from fundamentals. As you can well imagine, it takes a number of articles to do this. In the meantime, with his usual thirst for knowledge, Tom has sent in a long list of other queries on a variety of subjects. We can't answer them immediately, will do so as soon as we can.

WELL, Tom, we told you quite a bit about diodes last month and there is quite a lot more we could tell you if we tried hard enough. But if you understand all that has gone before you haven't done too badly.

On the other hand, if you wish to dig right down to the fundamentals of things you will find plenty of weighty volumes in the libraries of our learned institutions. Maybe you will want to become a professor some day, Tom, but in the meantime the best plan is to push on and get a good grasp of the whole subject.

The next step is the three element, or triode, valve. The addition of the third electrode vastly extends the range of functions which can be performed by the valve because it provides us with an easy means of controlling the electron flow.

CONTROL GRID

It consists of a spiral or mesh of wire, called a grid, surrounding the cathode and separating it from the plate. The turns of the spiral are sufficiently far apart to allow electrons to flow from the cathode to the plate if need be, but close enough together to have a profound effect on their flow.

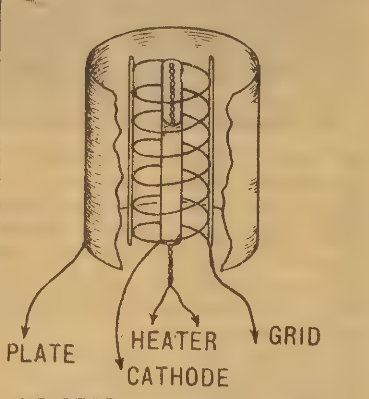
A diagram will help to make things clearer, Tom, so have a look at Fig. 1, which shows a three-element, or triode, electron tube.

In Fig. 2 we have shown a cross-section of the same valve so that you can see better how the electrons behave.

Already familiar are the heated cathode at the left with the space charge surrounding it and the plate to the right. As before, the plate is positive with respect to the cathode and therefore tends to attract the negative electrons. However, the spiral grid of wire between the cathode and plate (a cross-section is shown here) is negative with respect to the cathode because of the small battery connected between them. It therefore tries to repel the electrons.

We have picked out one electron from the many millions moving about near the cathode and shown a simplified idea of the forces acting on it. There is a force due to the positive charge on the plate tending to pull the electron and forces each from adjacent grid wires tending to repel the electron back towards the cathode. You understand, of course, Tom, that there aren't any wires or strings inside the valve to exert these forces but lines with the arrows are a convenient way of illustrating the forces.

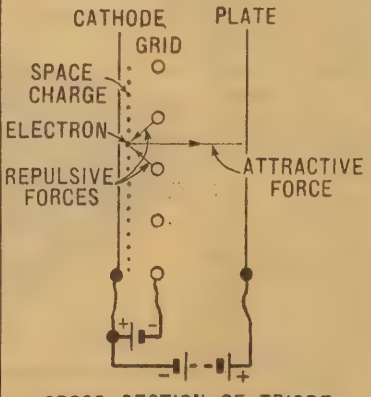
The force that the charge exerts on the electron depends on the strength of the charge and the distance between the charge and the electron. The stronger the charge the greater the force but the greater the distance between the electron and the charge the smaller the force.



INDIRECTLY HEATED TRIODE

FIG. 1

A triode, or three element valve, contains a grid in addition to the plate and cathode of the diode. Battery operated triodes have a directly heated cathode consisting of a filament of wire.



CROSS-SECTION OF TRIODE

FIG. 2

An enlarged cross section of a triode valve. Electrons near the cathode are attracted by the positive plate but repelled by the negative grid. Being closer to the cathode, the grid has a greater effect on electron flow than the plate.

You can see from the diagram that a smaller charge at the grid will be required to have the same effect on an electron at the cathode, as a given charge at the plate.

If you keep the plate charged positively at a fixed amount by means of a battery you can vary the plate current by varying the voltage applied to the grid. In a practical valve quite a small change in grid voltage will result in a large change in plate current. Provided the grid is kept negative with respect to the cathode no electrons will actually flow to it so that no current will flow from the battery in the grid circuit.

If need be, Tom, you can have a very large triode valve controlling large currents, controlled by a tiny battery. If you think about it for a moment you will agree that a valve is a very marvellous device indeed.

CUT-OFF VOLTAGE

Should you so desire, the grid voltage can be made more and more negative until eventually a condition will be reached when the repulsive force exerted by the grid will be greater than the attractive force exerted by the plate and no electrons will succeed in leaving the vicinity of the cathode. The greater the plate voltage the greater the negative grid voltage required to prevent plate current flowing.

You can see that the plate current depends on the plate voltage, the grid voltage and also on the relative distances of the plate and grid. Also the spacing between the turns of the grid has an effect. The closer the grid turns, the smaller the change in grid voltage needed to produce a given change in plate current.

If a valve designer wishes to make a valve to give big changes in plate current for small changes in grid voltage, he provides a very fine grid close to the cathode. The limit is reached when the grid is so close to the cathode that there is a danger of it shorting when subjected to vibration or when there is warping due to changes in temperature.

Although not of such immediate

all about triodes...

importance, it is interesting to consider what happens when the grid is made positive with respect to the cathode.

In this case, both the grid and the plate attract electrons from the cathode. Some of the electrons go to the grid so that a current flows in the grid circuit. The majority, however, come under the influence of the plate before they actually reach the grid. The result is that a high plate current flows. There are some valves designed specially for this type of operation and we will discuss them later.

TRIODE CURVES

A graph can be used to express the characteristics of a triode as well as a diode. You could fix the grid voltage at some convenient value and observe the plate current for various plate voltages.

However, we usually have a battery of fixed voltage to supply the plate and we are more interested in the change in plate current with change in grid voltage. This is shown in Fig. 3, a typical sort of valve curve.

With the grid at zero voltage (in other words, returned to cathode), the plate current for this particular valve is 30 units. If you apply a positive voltage to the grid, the plate current increases very rapidly. With only 1.5 volts positive it is 60 units.

On the other hand, 1.5 volts negative brings the plate current down to less than 10 units. A particularly interesting point to note is that about 2.5 volts negative is sufficient to stop the plate current altogether. For greater negative values than this the plate current no longer flows.

Of course, if you increase the plate voltage, it would require a greater negative bias to stop the plate current. The dotted curve on the diagram shows the characteristic for the same valve with a higher plate voltage.

PRACTICAL USES

If our guess is right, Tom, you will be on the point of asking how the triode valve can be put to use.

The most obvious, of course, is to use it to control the flow of current throught some circuit. For example, you could connect an electric lamp in series with the plate circuit and vary the light given out by the lamp by varying the grid voltage. Alternatively, you could vary the speed of an electric motor by placing it in series with a valve.

In practice, there are usually easier ways of varying the brilliance of lamps and the speed of electric motors. This sort of service usually does not require the operation to be performed instantaneously and the most important feature of the valve is wasted.

The thing which a valve can do that other control devices cannot is respond immediately to changes in grid voltage. This property enables it, when connected in suitable circuits, to amplify radio energy oscillating many millions of times a second.

It's a very interesting subject, Tom, and we will go on to tell you something about it.

A simple case where the need for amplification arises is an ordinary crystal set with which you are probably already familiar.

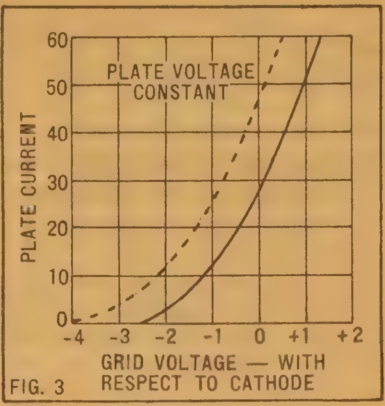


FIG. 3

A change in grid voltage causes the plate current of a triode to change. The characteristic curve of a typical triode is given here. The dotted curve is for the same valve but with a higher plate voltage.

You will remember that after passing through the radio transmitter, travelling through space and then through the crystal set itself, the signal consists of a tiny electric current which varies in sympathy with the original sound in the radio studio. The current can be applied directly to the headphones which will reproduce the sound.

NEED FOR AMPLIFIER

The difficulty is that only a small part of the energy radiated by the transmitter reaches the receiving aerial and thus only a weak signal is passed on to the headphones.

If the headphones be replaced by a resistor the signal currents will flow through the resistor and cause a difference of voltage across the resistor. In a particular case, the voltage can be worked out from Ohm's Law which states that the voltage is equal to the resistance multiplied by the current. In this case the resistance is a fixed value and the current is varied. You can see that the greater the current the greater the voltage developed.

This is where the triode valve comes in.

The grid of the valve can be connected to one end of the resistor and the cathode to the other. We then have a voltage applied between the grid and cathode of the valve which varies in sympathy with the signal.

With the plate battery connected, the current in the plate circuit also varies in sympathy with the signal but, because of the action of the valve, the change in plate current is very much greater than the change in current flowing through the resistor. In other words, there is an amplified signal at the plate of the valve.

The energy to operate the headphones comes from the battery in the plate circuit so that the minute amount of energy coming in via the aerial is only used for control purposes.

If operated exactly as just described, most ordinary valves would draw excessive plate current and there would be times when the grid would be positive with respect to the cathode and current would flow in the grid circuit. If this happens, the grid circuit requires power and, for this particular purpose, the valve is not so efficient as an amplifier.

BIAS METHODS

To avoid grid current, a BIAS voltage is applied to the grid, making it negative with respect to the cathode. The signal voltage is then superimposed on the bias voltage. The grid can only become positive with respect to the cathode if the signal voltage becomes greater than the bias voltage.

The bias voltage can be applied in various ways. A battery can be used in an arrangement similar to that shown in Fig. 2, except that the signal voltage is applied across a resistor in series with the bias battery. Sometimes the current through the valve itself is allowed to pass through a resistor and so develop a voltage which can easily be used as grid bias.

The resistor is placed between the cathode and the negative terminal of the plate battery, so that the plate current of the valve flows through it. This makes the cathode positive with respect to the battery terminal. If the grid is returned to the battery terminal it will then be negative with respect to the cathode. A large value condenser is connected across the resistor, so that the quick fluctuations in plate current with signal will not affect the steady bias voltage.

The scheme has the advantage that a separate bias battery is not required and for this reason is the most common method used. If you

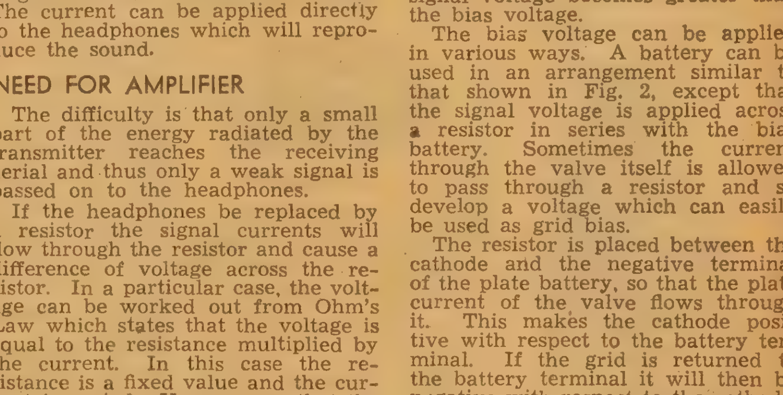


FIG. 4

At the left is a simple triode amplifier stage which could be used with a crystal set if desired. The amplifier at the right is a development of the simple version and two or more may be used one after the other to give greater amplification.

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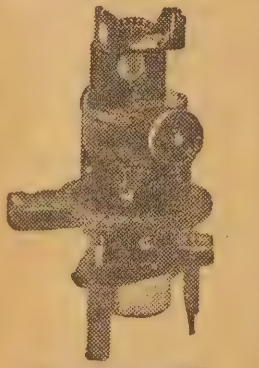

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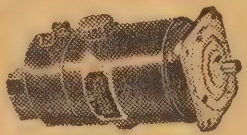

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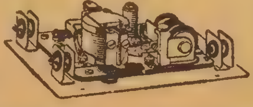

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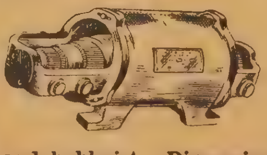

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know the bias required and the plate current, the value of the resistor can be calculated from Ohm's Law Simply divide the bias voltage by the current and you have the value of the resistor in ohms. Note, however, that the current must be expressed in amps, not milliamps.

In the case of low-powered amplifiers, such as are used to operate headphones from a crystal set, the voltage applied to the plate is very low and the valve does not draw excessive plate current, even if we return the grid to the cathode. At the same time the positive excursions of the grid are so small that the grid current is negligible. But remember this applies only to very low plate voltages.

Getting back to the valve as an amplifier, Tom, there are frequent occasions when the degree of amplification given by one valve is not sufficient, and it is desired to add another valve to amplify the output of the first.

RESISTIVE LOAD

If, instead of wiring the phones in the plate circuit of the valve you wire a resistor, the varying plate current, which has to flow through the resistor, develops varying voltages across the resistor. This can be passed on to the next valve.

A direct connection would cause the plate voltage of the first valve to appear at the grid of the second and thus upset the bias. To avoid this, we wire a condenser from the plate to the grid of the next valve. The condenser has the property of passing the signal, but preventing the flow of the steady current from the battery.

Several such stages can be used to provide very high degrees of amplification, and by suitable arrangement the same plate battery can be used to supply them all. There are practical difficulties which prevent more than a certain number of stages being used.

In a radio receiving set, where extremely high degrees of amplification are needed, amplifiers are often placed so as to amplify the radio frequency signal before application to the detector. This amplification can be added to the amplification after the detector.

Simple triode valves can be used for radio frequency amplification given suitable circuits, but four and five element valves are much more suitable. Tetrodes and pentodes, as they are called, will be the subject of next month's article.

In the meantime, see what triode valves you can locate and note the construction of the cathode, grid and plate. There are many types in common use.

A very worthwhile possession is a valve data book. It gives the filament or heater voltages and currents as well as characteristic curves and typical operating conditions. The valve companies make them available for a few shillings, Tom, so see if you can get hold of one from your radio dealer.

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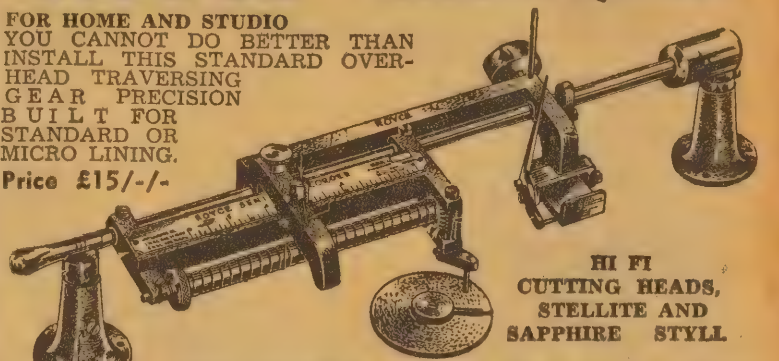

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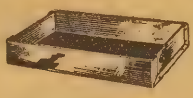

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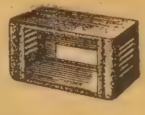

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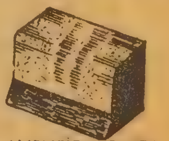

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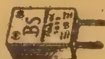

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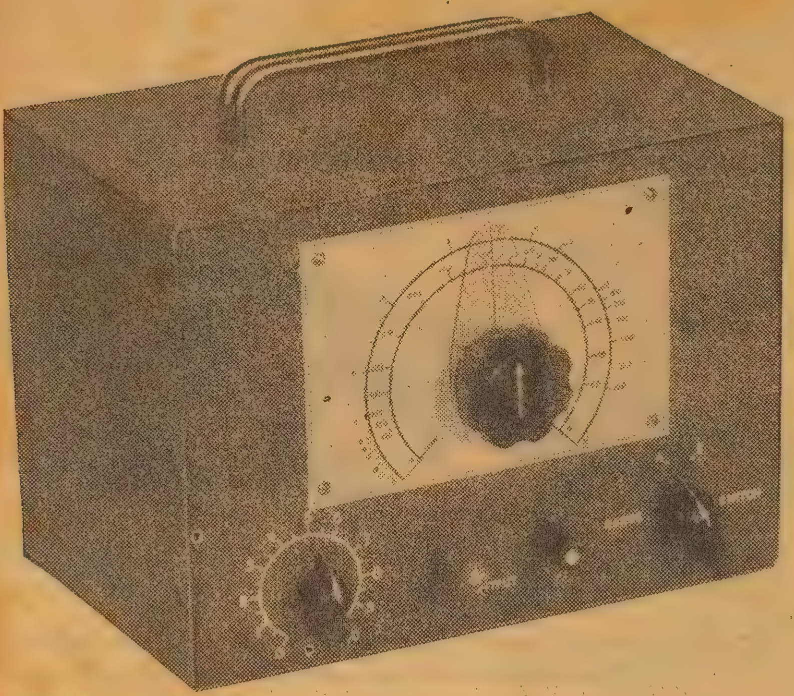


The standard instrument case is 9in x 6½in x 5½in. Along the bottom from left to right are the attenuator, the output terminals and the range switch. The frequency indicating pointer is mounted on a large knob.

AN AUDIO TEST OSCILLATOR

Full coverage from 20 cycles to 20 Kc, output within 1 db of reference level throughout the range and sufficient output to fully load any amplifier you are likely to use! These are the specifications of our new audio oscillator. It is a sure-fire circuit requiring no low tolerance components. It's what you've been waiting for!

by Maurice Findlay

ANYONE interested in audio work is unlikely to dispute the value of a good audio oscillator. It is the basic instrument for most tests on amplifiers, loudspeakers, filter networks and all components concerned with the reproduction of sound. You simply can't do any worthwhile experimenting without one.

The requirements of a good oscillator are fairly simple to state. First of all it must cover the entire audio range. It is also a distinct advantage if the output is level over the range. Frequency response runs on amplifiers can then be made simply by observing a single output meter.

STABILITY

It almost goes without saying that the instrument must be capable of holding its output level and its frequency calibration over a long period of time.

Radio and Hobbies has described several instruments with these general requirements in mind. Some of our readers will remember an elaborate audio signal generator which was described in 1945. It included a special low impedance output stage, a vacuum tube voltmeter and all the trimmings. The essential electrical design of the instrument is by no means outdated and would not disgrace any test laboratory.

Many readers also have built the simpler audio oscillator which was described in the July, 1949, issue and found it a very useful instrument.

Both used resistance capacity networks in the frequency determining circuit and you will find this a feature common to a large proportion of variable frequency audio oscillators. The reason is that prohibitively large values of inductance and capacity are required to resonate in the audio range, particularly toward the low end and, if the frequency is to be continuously variable, either the inductance or the capacity must be varied.

Of course, the desired result can also be achieved by feeding the output of two radio frequency oscillators into a mixer stage and selecting the difference frequency. Some commercial instruments use this principle but, for home builders, there are considerable difficulties.

PHASE ROTATION

The oscillator described here employs a resistance capacity network in the frequency determining circuits. We cannot claim to be the originators of the arrangement, which has been featured in a number of publications, both English and American.

The circuit which determines the frequency at which the instrument operates is essentially a frequency selective phase changer. A signal of a particular frequency fed into the network is rotated in phase by 90 electrical degrees when delivered at the output.

If, after passing through the first network, the same signal is passed through a second identical network, the output from the second network will be changed in phase by a further 90 degrees, making a total of 180 degrees.

If the signal is then passed through a normal valve amplifier, a further phase change of 180 degrees results and the total phase rotation from the input of the first network to the output of the amplifier is 360 degrees. In other words, the signals at the input of the first network and the output of the amplifier are in phase.

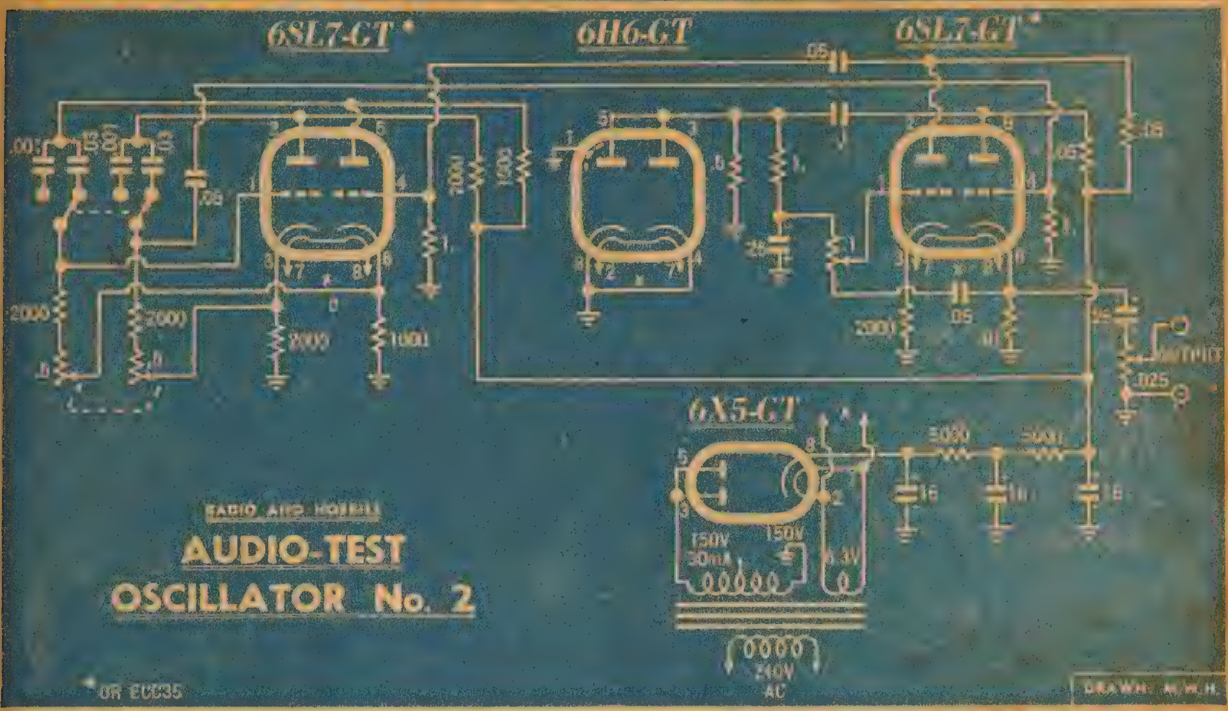
If they be connected together to complete the round circuit and the gain of the amplifier is high enough to overcome the losses in the system, oscillation will take place.

RESISTANCE CONTROL

The frequency at which the system oscillates is the frequency which is selected by the resistance capacity networks for the 90 degree phase change. It can be varied by varying either a capacity or a resistance in the network.

In our particular case it is more convenient to vary the resistance and leave the capacity constant for each range. With two phase changing networks involved, two variable resistors are required. These can

CIRCUIT DOES NOT SPECIFY CRITICAL COMPONENTS



The circuit will probably appear strange on the first encounter. The frequency determining circuit is to the left with the amplifiers and AGC detector to the right. As it stands the output is about .8 volt maximum. If desired, it can be reduced to .5 volt as discussed in the text.

conveniently be mechanically linked together and operated from a single control.

A satisfactory explanation of the phase rotating circuit involves vector algebra and most of our readers will be more interested in making an instrument that works than concerning themselves with the niceties of mathematics.

The release of ganged potentiometers by a local firm coincides with publication of this article, which is fortunate. It means that the instrument can be constructed entirely from components available over the counter in the ordinary way.

ORDINARY POTENTIOMETERS

However, before we knew of the release of the new potentiometer, we set to work to evolve a scheme to gang two ordinary potentiometers and eventually hit on the idea shown in the published photograph. It only takes a few minutes to make up the extra parts from scrap sheet metal and the result is very satisfactory.

Don't worry about the potentiometers being accurately in step to a fraction of a degree. In fact, you can vary the frequency of the instrument quite successfully over a limited range with one potentiometer only.

The "maintaining" amplifier requires special consideration. Its gain must be such as to maintain the oscillations at the required amplitude and yet not so great as to cause any of the stages to overload. Too much gain will cause the output waveform of the instrument to be poor.

A manual gain control could be used to control the feedback, but its setting would have to be altered every time the frequency is changed. Inconvenient to say the least!

In practice it is not too difficult to arrange an automatic amplitude control system functioning along the same general lines as the usual receiver AVC system.

Some of the output of the oscillator is amplified separately and rectified by a diode valve so that a negative voltage is developed, its value being proportional to the strength of oscillation. The negative voltage is filtered and then applied to the grid of the amplifier valve.

The greater the negative voltage applied to the valve the smaller its gain. As soon as the gain goes down the negative bias developed by the rectifier is also reduced, allowing the gain of the amplifier to rise again. If the time constant of the filter circuit is made long enough, the amplitude of oscillation will eventually reach a steady level and remain at that.

FILTER CONSTANTS

A minor disadvantage is that the time constant of the filter network has to be made very long in an instrument which covers down to 20 cycles and it takes some seconds for a steady state to be reached. There are few applications where this is likely to be a real worry.

When translated into a practical circuit, 4 triode elements and a diode are required. The first two triodes serve simply to provide the balanced input required by the phase rotating networks, a third acts as a maintaining amplifier and a fourth as an automatic amplitude control amplifier. The diode is used as the amplitude control rectifier.

The total number of valves can be reduced by using a pair of twin triodes. High-mu types are required

PARTS LIST

1 instrument case 9in x 6½in x 5½in.
1 chassis 8in x 5⅜in x 2¼in.
1 power transformer 150-0-150v & 6.3v.
1 2-gang potentiometer, .5 meg. per section.
1 .1 meg potentiometer.
1 .025 meg. potentiometer.
1 2 x 2 rotary switch.

VALVES

2 6SL7-GT, 1 6H6-GT, 1 6X5-GT.

RESISTORS

3 1.0 meg, 1 .5 meg, 2 .05 meg, 1 .01 meg, 2 5000ohm, 5 2000ohm, 2 1000-ohm.

CONDENSERS

2 25 mfd 40V, 3 16 mfd 525V, 1 .1 mfd 400V, 3 .05 mfd 400V, 2 .03 mfd 400V, 2 .001 mfd 400V.

SUNDRIES

1 large knob, scrap celluloid, 2 pointer knobs, 2 terminals, tag strips, hook-up wire, tinned copper wire, spaghetti, solder lugs, 4 octal valve sockets, rubber grommets, power flex, power plugs, &c.

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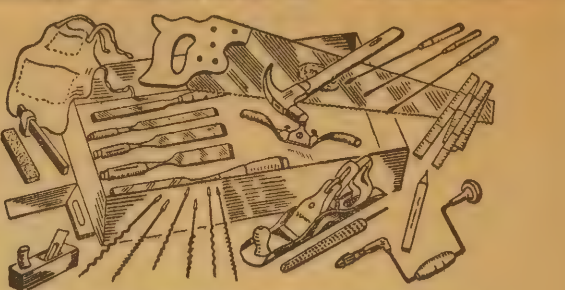

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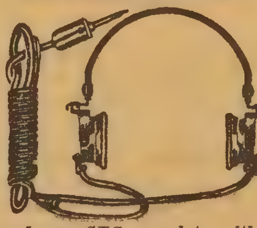

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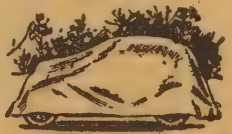

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and so far we have found the 6SL7-GT and the ECC35 equally satisfactory. Possibly some of the high-mu twin triodes in the miniature range could be used, but we have not as yet had the opportunity to try them.

For the rectifier, type 6H6-GT is an obvious choice. Both diode elements can be connected in parallel. If you have any other valve which you would like to use, its plate and grids can be connected in parallel and used as a diode plate.

LOGARITHMIC TAPER

The dual potentiometer has a resistance of .5 meg per unit and should preferably have a logarithmic taper in order that calibrations be conveniently spread over the dial. Logarithmic potentiometers are normally used for volume controls and are therefore a standard item. In this instrument the wiring should be arranged so that maximum resistance is in circuit when the controls are turned fully clockwise. This will be the low frequency end of the range.

Even with the preferred type of potentiometer, there will be some crowding of the scale at the high frequency end but the ranges can be chosen so that this does not occur where accurate calibration is required.

An improvement in this regard is effected by wiring a small fixed resistor in series with the variable element. The resistor also prevents the instrument going out of oscillation as would happen with zero resistance in circuit. Anything between 2000 and 5000 ohms is suitable. The higher value will limit the coverage at the high frequency end of the range but improve the scale. The ratio between the maximum and minimum frequency for any given range is about 10 to 1.

The frequency range is set by a pair of fixed condensers, one in each of the phase rotating networks. For a given resistance in circuit, the larger the value of the condensers, the lower the frequency. We found by experiment that with .5 meg in circuit about .03 mfd was required to make the circuit oscillate at 20 cycles. There is little point in attempting to go lower than 20 cycles.

With .03 mfd, the coverage is from 20 cycles to about 2 Kc. The higher end of the scale is fairly crowded but good bandspread is obtained up to about 500 cycles.

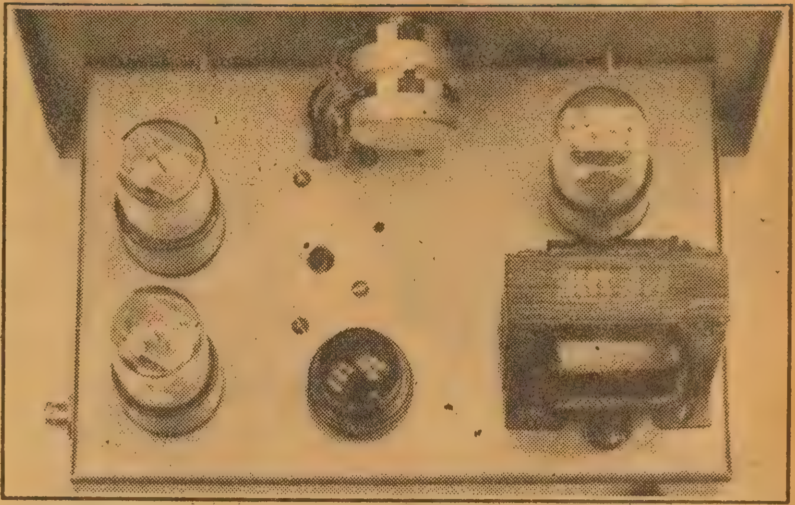
RANGES

For the next range, .001 mfd gives coverage from about 300 cycles to about 30 Kc. This allows a nice overlap with the previous scale and accurate calibration up to 20 Kc. The overlap is such that normal variations in component specifications will allow the required ranges to be covered.

Of course, if you have any special preferences, you can vary the values to suit. However, if you try to extend the range above 30 Kc or below 20 cycles, difficulties may be encountered in keeping the level constant and the waveform good.

The circuit shows the two pairs of condensers switched separately, but if the .03 mfd condensers happen to be low in value it would be in order to leave the .001 mfd condensers in circuit all the time and simply switch the larger condensers in paralled with them for the low frequency range.

A TOP VIEW OF THE OSCILLATOR



The 2 6SL7-GT's are to the left, then the 6H6 and the 6X5-GT and power transformer to the right. There is sufficient space to use either a pair of ordinary potentiometers ganged together or one of the new dual potentiometers.

As it is, the level is within 1 db of the 1 Kc reference level throughout the whole range. Over the greater part of the range it is actually a good deal better than this. The waveform is also excellent over the whole range including the 20 cycle region where many similar commercial instruments are often far from being above reproach.

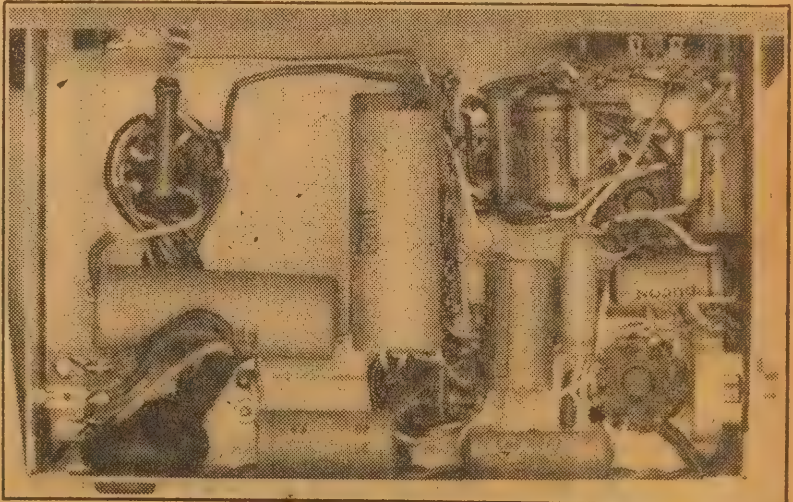
The exact voltage of the output will depend on the values of components but will be about .8 volts as an average. Few amplifiers will require as high as this for full loading so that there is plenty to take care of all likely circumstances. You could instal a simple network to reduce the output to some even value such as .5 volts. With a linear potentiometer used as the output control an ordinary linear scale would give a reasonable indication of the output.

Assuming that .8 volts appears on the output side of the 25 mfd condenser, a 15,000 ohm resistor wired between the condenser and the top of the 25,000 ohm pot., will reduce the maximum output of the instrument to .5 volts. On a scale with 10 divisions for the full 270 degrees of rotation each division would then represent .05 volts.

VTVM CHECK

The figures given will give reasonable accuracy if you have no vacuum tube voltmeter but you will, of course, check them if an instrument is available.

The tolerance of the output circuit to varying load is good. The fact that the output is taken from the cathode circuit of a valve helps in this regard and also the automatic amplitude control circuit helps to keep the output level. No falling off in output with loading will be



There is ample room for all components underneath the chassis. The phase rotating circuits and their associated 6SL7-GT are at the top right. In the centre, two 16mfd electrolytics are mounted one above the other.

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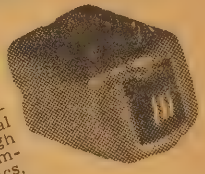

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RECORD-PLAYBACK HEAD (for Tape)	£6
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MA6480 **MAGNETIC PRODUCTS PTY. LTD. 124 BATHURST ST., SYDNEY.**

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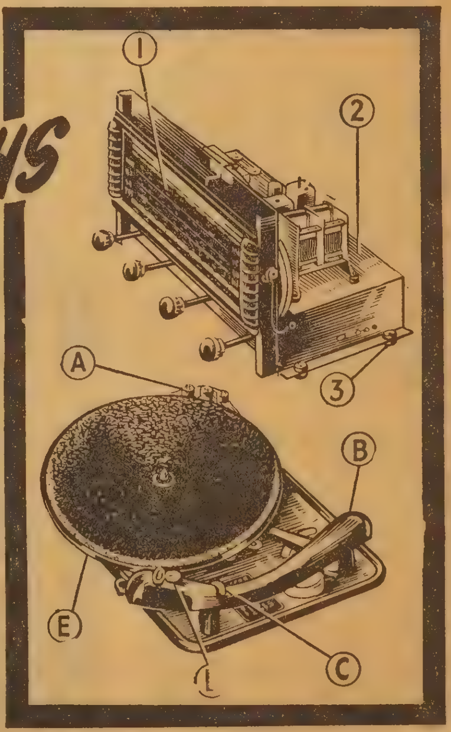

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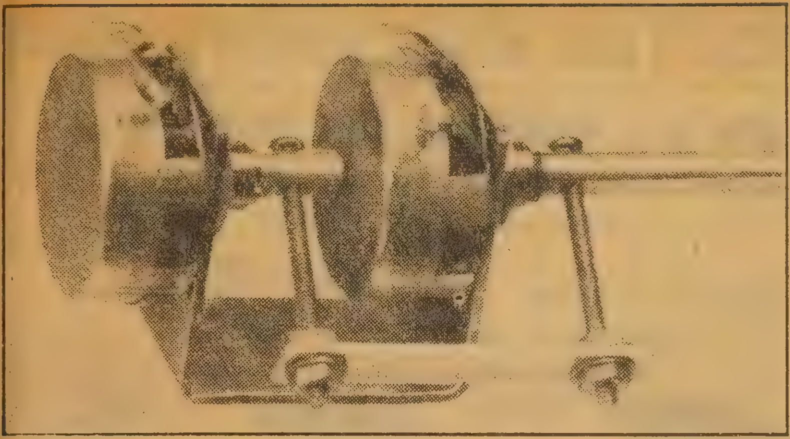

The above is an excellent means of ganging two potentiometers. In this case the bracket is 1½in x 1½in x 1in wide and the pots. are mounted 1in above the chassis level. The ⅛in bolts are 1½in long and the connecting strap 2in.

noticed with load resistor values above about .05 meg.

As we mentioned earlier, the time constant of the automatic gain control circuit has to be large for successful operation at 20 cycles. If you shift quickly from the centre of either range to one of the extremes it will take several seconds for the output to come back to the reference level. Actually, if you shift quickly to the low frequency end of the lower range, oscillation may cease for a few seconds until the filter condenser has discharged.

Putting the instrument into operation is a very simple matter. It boils down to finding a setting of the .1 meg feedback control which will ensure oscillation over the entire range. At the same time the feedback should not be so great that distortion occurs at points on the range where the gain of the maintaining amplifier is high.

In practice, it is best to adjust the feedback at the low frequency end of the low band so that the circuit just oscillates. Start with the control in the minimum position and leave it there for 30 seconds or so before advancing the gain. The idea is to make sure that the filter condenser is fully discharged.

FEEDBACK SETTING

The setting of the feedback control is not at all critical. It has to be grossly over-advanced before distortion becomes noticeable. The position of the control does not affect the calibration.

For the high tension supply, the instrument requires about 300 volts at 6 mA. By using the two halves of a small 150V-0-150V transformer in series and a half-wave rectifier the high tension requirements can be met easily. The current is low and a two section resistance capacity filter renders the high tension completely free from ripple.

The instrument can take practically any desired physical form. We found it convenient to instal it in one of the standard small instrument cases which are a stock item with radio supply houses these days.

For the benefit of those who do not care to undertake punching and filing holes, we intend to prepare a special blueprint of the chassis and panel and pass it on to the people who look after these things. You will, therefore, be able to order a complete chassis from your radio dealer.

The layout we have used is obvious from the photographs. It is only one of the many possible and practically any other reasonable layout may be used.

If you have been accustomed to wiring receivers and amplifiers, the circuit will probably seem a little strange. There is really nothing difficult about it. Simply follow the schematic circuit for each connection. You will need a few tie points other than those provided by the valve sockets and switch. A tag strip mounted alongside the valve sockets will assist in making a neat job.

WIRING PROCEDURE

Probably the most logical wiring sequence is to instal the various plate, cathode load and grid return resistors first as these occupy the least space. The condensers, which take up more room, can then be placed on top where there is more space available.

A good wiring job would allow every connection to be visible should a mistake or faulty component make a subsequent check necessary.

Before the job can be considered complete, the oscillator has to be calibrated. There are a number of points to be watched in doing this and we intend to make it the subject of a short article next month.

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A portable takes entertainment *everywhere* — indoors, outdoors. All year round you'll be glad you made your second radio a portable powered with

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EQUIPMENT FOR THE V.H.F. ENTHUSIAST

NEW H. F. RECEIVERS AND TRANSMITTER

COMPLETE WITH FOURTEEN 6.3V VALVES AND PLUGS, etc.
IDEAL FOR 144 MEG. BAND

NEW IN CARTON **£4/17/6** GENUINE BARGAIN

PHOTOSTAT OF CIRCUIT 7/6 EXTRA

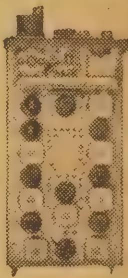
American Radar Transmitter Type ASB

CONTAINS

Two U.H.F. Triodes Type 15 E
Four Sets of Lecher Bars.
Transformers, ceramic mountings, Motor Blower, etc. Also High Voltage Vacuum Change-Over Relay. Nominal Frequency 515 m/cs. Ideal for conversion to U.H.F. Channels, Variable Coaxial Cable and Link Matching Lines.
Contained in Aluminium Case.
Dimensions 18in x 7in x 8in.

£3 PLUS FREIGHT

AMERICAN H.F. RECEIVER ASB



Complete with 11 tubes, 7 6AC7, 2 6H6, 2 955 Acorns. Can be altered to 144 or 280 Mc amateur band or FM band.

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NINE VALVE RECEIVER WITH R.F STAGE FOR THE—144M.C. BAND

(*Response Unit*)

9 VALVE RECEIVER USING 6.3V VALVES
SUPPLIED WITH VALVES AND PLUG

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Range 0-14 Amps
Scale Size — 4in.
Dia. Brand New
Price, each,

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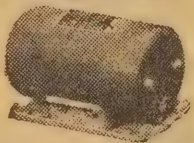
Packing and postage: NSW, 3/-; Interstate, 5/6.

GENEMOTORS



Midget type as illustrated, input 28 volts, output 250 V at 60mA .. 35/-
TR1133 type, input 12 volts, output 300 volts at .24 amps, 150 volts at .01 amps, 6 volts at 5 amps. Filtered 90/-
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Dynamic Mike Inserts	6/-
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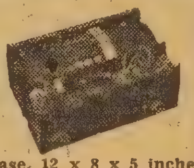
NEW VELCO 6-VALVE D-W RECEIVERS

240v AC 50 cycle ex-amenities services. Provision for two extension speakers. Metal cabinet. Price each F.O.R. **£19/10/-**

SCR 522 TRANSCEIVERS

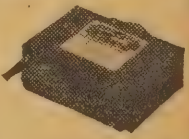
Freq. range 100 to 156 m/cs complete with valves **£24/10/-**
Genemotor supply for above (28V) with filter __ **£2/15/-** F.O.R.

SCR522 GENEMOTORS



28 volt intput regulated and filtered; output filtered 300 volts at .26 amps; 150 volts at .01 amp; 14.5 volts at 5.0 amps.
Completely shielded in metal case, 12 x 8 x 5 inches.
Price, F.O.R. Each **55/-**

SCR522 CONTROL UNITS



Comprising 5 pole push button switch, 2-way key switch, 5 lamp jacks, bezels, and lamps, etc.

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Covering 140 KC. to 20 M.C. in two separate tuned circuits with provision for crystals and V.F.O. Complete with valves.
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Aerial coupling unit for above £2/-/-.

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All above are 2" flush mount

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Special purchase of 1000 new Permagnetic speakers made by one of Australia's leading manufacturers enables us to sell these units at half price.

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WITH 15,000 OR 20,000 TRANSFORMER 50/-
Separate Transformers to suit any of above speakers—5000 ohm 8/6 each. (Supplied with speakers only).

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12in SPEAKERS	7/6	12/6
8in SPEAKERS	5/6	9/6
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1K7G	8/6
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1L5G	10/6
6K7G	8/6
6U7G	12/6
6SA7GT	12/6
6SK7GT	12/6
6SQ7GT	12/6

Please add postage.

3S4	15/-
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7193	5/
EF50 with socket	11/6
6H7 OR 1K5	5/

In dozen lot.

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8 MFD-525v **3/6** each or **34/-** dozen plus post.
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16 MFD-350v **3/-** each or **30/-** plus postage.

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.25-200v	5/6 per dozen
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Permatune I.F. trans. 455K.C.	9/6
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Teletron 8-pin octal moulded sockets **5/-** per dozen or **25/-** per 100.
American 8-pin octal high insulation **5/-** per dozen or **25/-** per 100.

CARBON RESISTORS

Well-known make of carbon resistors in values of 100 ohms to 250,000 ohms In 1-watt, ½-watt and 1/3 watt All resistors are standard color coded and in original cartons In lots of 100 mixed values comprising 50 1-watt, 25 ½-watt, 25 1/3-watt. Post free. **12/6**

IN LOTS OF 500, 50/-.

SOLDER

English resin multi-core solder in 1lb reels,

12/6 per lb.

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Standard Crystal Holders (new)

4 £1/1/- or
£2/10/- per doz.
(pins ¾in centres)

TRICKLE-CHARGER KITS

Kits for trickle-charger as described in R & H June issue. Comprising transformer with 18V winding tapped at 12V—3 100 Ma rectifiers and 50 ohm control.

39/6 Postage: NSW., 5/-; Interstate, 7/6.

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H.D. Power Transformer 265 x 265
150 Ma., 4v Fil. Windings **£2/5/-**
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English B.S.R. 4 pole synchronous motors 240V or 110V A.C. Ideal for that tape recorder.

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(At top of Taverners Hill)
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A COURSE IN TELEVISION

*PART 48 — INTERFERENCE FROM AUTO IGNITION

Though our television course was terminated as a regular feature in the April issue, we plan to publish additional chapters from time to time. This article, reprinted by courtesy of "The Motor" is an excellent survey of the interference problem as it affects British television viewers using frequencies in the 40 to 70 Mc. region.

IT is now generally known that the electrical ignition system of the internal-combustion engine is the major source of interference with television reception. The interference takes the form of white spots or blobs on the screen and may give a buzzing noise from the loudspeaker.

The effect of the interference on the sound channel of modern television receivers, which usually have noise limiters, is less pronounced than on the screen, and it is in general, true to say that, if the screen interference is removed, the sound interference will also disappear.

The severity of the interference depends on many factors and can vary from a few small white dots to many large white blobs, which may coalesce into a white band moving up or down the picture and completely ruining its entertainment value. The main factors involved are:—

(a) The strength of the television signal, which controls the sensitivity at which the set is operated.

(b) The strength of the interference itself.

(c) The type of aerial used, and

(d) The position in which that aerial is erected.

LOCATION IMPORTANT

The strength of (a) depends on the distance of the receiver from the transmitter. Thus, a viewer living within a mile or two of a transmitter, may never suffer from ignition interference, where one living on the fringe of the service area may rarely be free from it.

A large number of measurements have been carried out by the Electrical Research Association and Joseph Lucas Limited, on pro-1939 and post-1945 vehicles with and without suppressors, and analysed relative to an interference level considered by the British Standards Institution to be the maximum permissible for satisfactory reception of television within the recognised service areas.

Although only the television frequency band is considered in the paper, it should be mentioned that the radiation from ignition systems is not confined to television frequencies.

Other radio services, both actual and potential, at higher frequencies than the 41-68 Mc per sec television band may be affected by ignition interference. Some of these are essential services on which the safety of life may depend.

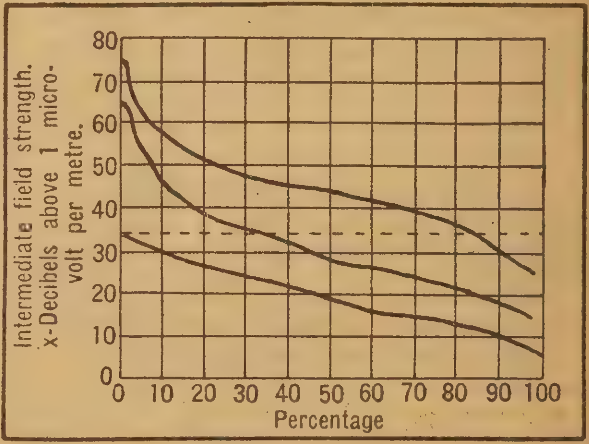
BY A. H. BALL, AMIEE, and
W. NETHERCOT, BA, B.Sc.

The possibility of the extension of broadcasting by the British Broadcasting Corporation to frequencies around 90 Mc per sec, must also be remembered.

Although it is only during the last year or two that interference with television has had much publicity, the problem has, for many years, been studied extensively by the interested organisations.

Committees of the British Standards Institution have prepared standards dealing with radio interference in an attempt to obtain uniformity in measuring technique and equipment, permissible limits of interference, and so on.

Two documents published by the institution, which are particularly concerned with interference from motor vehicles are Code of Practice No. 1001, Abatement of Radio Interference caused by Motor Vehicles and Internal Combustion Engines, and British Standard, No. 833, Radio Interference Suppression for Motor Vehicles and Internal Combustion Engines.



☆

Interference produced by post-1945 vehicles (1) without suppressors, (2) with a single suppressor in the coil distributor lead and (3) with resistors fitted to the plugs as well. See table on next page for analysis of engine performance with and without suppressors.

☆

No legal power for the control of radio interference existed in Britain until the Wireless Telegraphy Act, 1949, was passed. This Act gave the Postmaster-General power to make regulations for the control of radio interference after consultation with an advisory committee, on which the various technical, manufacturing, and user interests are represented.

The committee produced a report in which it was recommended that "manufacturer" and "user" regulations should be made covering the frequency band 40-70 Mc per sec. and that the requirements be such that the interference producing field should not exceed 50 microvolts per metre at a distance of 10 metres from the source.

This was the same as the British Standard (BS) value quoted earlier, but only applies to ignition equipment.

The Postmaster-General has implemented some of the recommendations of the advisory committee by the issue of The Wireless Telegraphy (Control of Interference from Ignition Apparatus) Regulations, 1952.

EXISTING VEHICLES

Private cars, commercial vehicles, motor-cycles, stationary and marine engines, and test equipment manufactured after July 1, 1953, will be required to comply with the regulations.

So far, no regulations governing vehicles already in service have been made, but it is possible that such regulations may be introduced later.

It will be shown that the attainment of the requirements of the regulations is neither difficult nor expensive, such aspects of the matter having been given very careful consideration by the advisory committee before specifying the field strength limit now embodied in the regulations.

Although it is not yet compulsory for owners of existing vehicles to carry out suppression, it is hoped that voluntary action on their part will follow. Such action has already been taken by many transport organisations and operators.

The wide-scale suppression of vehicles to the limit of the regulaons will not eliminate ignition inerference completely, but will nevereless improve matters very considrably for all viewers. It can be exected to reduce the interference to really tolerable level for probably s much as 80-90 pc of the potential iewing population of the country.

In drawing up the proposals for he regulations, the advisory comittee assumed that television manuacturers will do so much as is reasnably practicable to reduce the suseptibility of the receivers to intererence by the incorporation of noise imiters. Also that all reasonable neasures would be taken with the nstallation such as the use of direcional aerials, where necessary, and heir siting away from roads carryng heavy traffic.

A complaint by a viewer who had eglected to help himself by using receiver under completely unfavorble conditions would not receive nuch support from the Post Office.

OVERALL BENEFIT

The regulation is a reasonable ompromise and with the co-operaion of both motorist and viewer gnition interference will be reduced o very small proportions.

Any sudden variation or interrupion of the current in a low-frequency r DC circuit will produce electromagnetic fields capable of causing inerference with radio reception. Such hanges occur in the normal operaion of many items of equipment on motor vehicle.

Examples are the ignition system, he generator, screen-wiper and fan motors, and the vibrating contact ciruit of voltage regulators.

The radiation from the ignition ystem, the major source of intererence from a motor vehicle, comes rom the capacity component of the gnition spark.

When the plug fires the energy tored in the self-capacitance of the plug, the high tension cables and the igh tension winding of the ignition oil or magneto is very rapidly disharged, giving rise to a high oscilatory current whose peak value may xceed 100 amperes, but lasting for ess than a microsecond.

Some of the energy in the circuit s radiated into space from the high ension cables and also from the low ension wiring, due to coupling with he high tension system.

As far as interference with reeivers not carried on the vehicle s concerned, it is true to say that nly the ignition system gives serious rouble and other equipment on the normal motor vehicle will not give nterference exceeding the 50 microvolts per metre limit.

SCREEN WIPERS

One important exception to this is the heavy-duty type of screen-wiper used on some commercial and public ransport vehicles.

These are often 24-volt machines and may produce an interference field particularly annoying to viewrs living near bus stops on busy outes, providing the explanation of the apparently puzzling phenomenon of a diesel-engined vehicle spoiling elevision reception.

The potentially interfering or "noise" field radiated from a vehicle depends on the construction of the vehicle and the layout of the elecrical equipment and wiring.

For example, a compact ignition ystem with coil, distributor, and plugs close together, with short high ension cables is likely to give less interference than one in which the components are spread out.

Engine design and other considerations can, of course, often preclude such a layout but, where possible, it is a desirable objective.

The radiated ignition field is also affected by the construction of the engine compartment and the bodywork around it. Some screen is provided by the metallic enclosure of the engine and this is naturally influenced by the completeness of the screen which in turn depends on how well the bonnet, side panels, &c., are electrically continuous.

Many factors in addition to the electrical conditions obtaining in the interference-producing circuit can affect the level of the radiated field. Thus, the considerable variations in the interfering property of different makes and types of vehicle, often observed by television viewers, are not unexpected.

Results on the effect of resistors of a 1½ litre four-cylinder O.H.V. engine.

Engine speed r.p.m.	B.h.p. Output	
	Without resistors	With 10,000-15,000 ohm resistor at distributor and at each plug.
1,000	13.5	13.5
1,500	22.1	21.9
2,000	30.0	29.9
2,500	36.8	37.1
3,000	42.5	42.9
3,500	45.9	45.9
4,000	46.7	47.2

As already indicated, it is usually only the ignition system that requires suppressor treatment in order to bring the vehicle within the BS limit. Ignition suppression can, for the present requirements, be obtained by the use of resistors (suppressors) in the high tension cables of the ignition system. The low tension wiring does not require attention.

SINGLE RESISTOR

For coil ignition systems the simplest method is to insert a single resistor of appropriate value at the distributor end of the coil-distributor high tension cable. If this is found to be inadequate, then additional resistors are fitted at the sparking plugs.

If still inadequate, then further resistors are fitted at the distributor ends of the sparking plug cables. It should be mentioned that this latter course has not been found necessary on any of the vehicles tested by the authors in order to comply with BS requirements at television frequencies.

The resistors should be inserted as near the sparking points as possible. Thus, the distributor resistor should be close to the distributor terminal and the plug resistors attached to the plug terminals and not in the cables several inches away. Failure to observe this rule may impair the suppression efficiency considerably.

The effect of suppression resistors in the ignition circuit is to change the high frequency discharge into a unidirectional one of much longer duration, with a reduction of peak current to less than one ampere. The amplitude of the current in the inductive or "flame" component, on the other hand, is substantially unaltered since the normal parameters of the circuit limit it to milliamperes.

Suitable values of resistors for ignition suppression lie between 5000 and 15,000 ohms. The resistance value is not critical, but below about 5000 ohms the suppression may be appreciably reduced, whereas a steady improvement is usually obtained as the value increases from 5000 to 15,000 ohms above which no worthwhile gain occurs.

For practical purposes there is little point in going outside the range 10,000-15,000 ohms. An important development has taken place in the design of some of the latest distributors now being fitted to new cars, in that a degree of suppression is incorporated in the distributor itself by the use of a resistive high-tension brush.

This consists of three parts, the two ends consisting of brush grade carbon of low specific resistance, while the centre part is of highly resistive material and forms the suppression resistor.

MAGNETO SYSTEMS

Although the vast majority of petrol engines are now fitted with coil ignition, magnetos have to be considered, and for them resistor suppression is equally satisfactory. However, the use of a standard type of suppression resistor as used for ignition coils is not recommended.

The reason for this is that the energy from a multi-cylinder magneto at speed is considerably greater than from an ignition coil, and a resistor designed for coil ignition used in the main high tension lead of a magneto would be severely overloaded, with consequent heating and liability to failure.

Ignition suppression resistors have to operate under conditions, both electrical and mechanical, which are much more severe than those for the average radio resistor. They have to withstand fairly high ambient temperatures, are subject to considerable vibration, and must not be affected by petrol, oil and water.

In addition, they are subjected to high electrical stress at every spark impulse. In fact, immediately after a plug has fired, a voltage comparable with the breakdown voltage of the plug gap is momentarily impressed on the series resistor. Thus, a minimum length of resistor is essential in order to prevent internal and external electrical discharges, which, if they occur, will rapidly cause disintegration of the resistor.

Wire-wound resistors are, in general, unsuitable and a special carbon material with appropriate filler and binding medium is used.

The mixture is formed into cylindrical pellets under pressure and heat. The pellets are ground to the required dimensions and the ends are copper sprayed in order to make electrical contact.

This type of moulded resistor is different from those used in radio receivers, and, to say the least, it is inadvisable to use one of the latter, or indeed, any resistor not designed for the purpose, in an ignition circuit.

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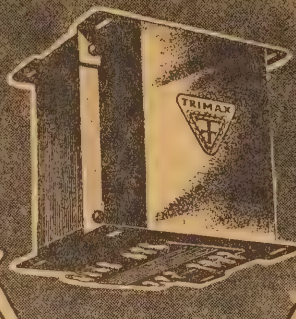

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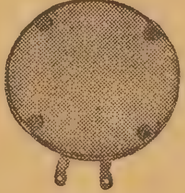

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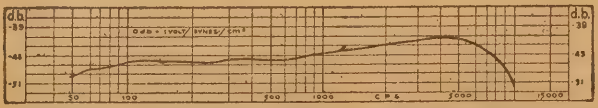

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The resistor elements are assemled into synthetic resin housings ith suitable end terminations. Proision is made for attachment to the gnition cable at one end and to the lug or distributor, as the case may e, at the other end.

The British Standards Institution as realised that a very high stanard of reliability for resistors is ssential if ignition suppression is o become widely adopted, and so the evised draft of BS833 specifies a ost severe 1000-hour test for supression resistors.

Any manufacturer's product comlying with this specification, can herefore, be used with complete conidence.

UILT-IN SUPPRESSORS

Another interesting development is he incorporation of a suppression esistor in the body of the sparkng plug, thus avoiding an external nit.

Although for some years now parking plugs for aircraft have been itted with anti-erosion resistors of ne or two thousand ohms, diffiulty has been experienced with the igher values used for suppression lue to premature failure as a result f the very high working temperaure.

However, new ceramic-base resistnce materials are now available, nd, it appears, that the stability roblem of resistors in sparking plug nsulators is well on the way to soluion.

Unfortunately, there has been some rejudice in the past against fiting resistors on account of the suposed adverse effect on engine perormance. However, the evidence ccumulated from carefully controled tests made by engine and car nanufacturers, is that, for normal ngines under normal operating conitions, suppression resistors have no ffect on performance.

That some of the larger motor nanufacturers are convinced of the ruth of this statement is shown by he fact that their vehicles have for ome time, been fitted with supression resistors as standard equipnent.

ENGINE PERFORMANCE

Complaints of resistors affecting ngine performance that have been nvestigated by the authors have inariably been due basically to some ther feature such as maladjustment f the carburettor or to an ignition ystem already on the point of failre. The use of resistors merely rought the faults into earlier promnence.

Probably some of the prejudice gainst resistors has arisen from the ffect they have in reducing the light ntensity from the spark, but it canot be emphasised too strongly, howver, that the brightness of a spark s not a criterion of its incendivity.

British and American military ehicles, other than those equipped ith screened ignition, have for nany years been suppressed by reistors to a higher degree than denanded by the regulations, and no dverse effects have been experinced. Indeed, tests made in both ountries have indicated that supression resistors may give a defiite improvement in starting at subero temperatures.

Motor manufacturers who have onducted comprehensive tests on ne effect of resistors on engine perormance have reported no difference in maximum speed, acceleration and fuel consumption. Typical results on the effect of resistors on engine output are given in tables.

Accusations have occasionally been made that suppression resistors adversely affect the components of the ignition system, such as the distributor contact-breaker and capacitor. Extensive endurance tests carried out by ignition component manufacturers have shown these to be completely unfounded.

One beneficial effect, not generally appreciated, is that suppression resistors may reduce considerably the erosion of the sparking plug electrodes, with the result that gap adjustment is needed less frequently and plug life is prolonged. It is for this reason that resistors are usually fitted in aircraft sparking plugs.

PLUG LIFE

A graph shows the results of an extensive series of tests in the frequency band 45-50 Mc per sec on post-1945 vehicles, mainly private cars.

Curve 1 is for unsuppressed vehicles, and about 85 pc gave levels above the BS limit and over 40 pc gave levels between 40 and 50 db above 1 microvolt per metre. In a few cases the interference level was between 60 and 70 db, and one abnormally high value 77 db above 1 microvolt per metre was recorded.

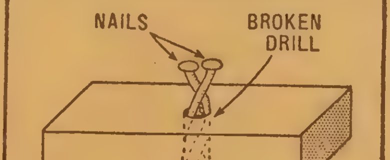
The effect of a single resistor is shown in curve 2. About 70 pc of the vehicles gave a level not exceeding the BS limit and 16 pc a level exceeding twice the limit.

In one or two cases a high level (50-60 db above 1 microvolt per metre) was recorded, but a somewhat greater percentage of postwar vehicles can be suppressed by the single resistor to the BS limit than of pre-1940 vehicles, possibly because more of the post-1945 models have the coil mounted on the engine-block.

The effect of adding plug resistors is shown by curve 3, and here again the interference is always reduced below the BS limit and in general is appreciably below it.

It has been shown that the magnitude of the ignition interference can vary considerably from vehicle to vehicle. The maximum and minimum levels recorded at frequencies between 45 and 50 mc per sec were 6000 microvolts per metre and 20 microvolts per metre, respectively, thus giving an overall variation of 300 to 1, or 50 db.

REMOVING BROKEN DRILLS



When a metal drill breaks off below the surface of the material, drive two thin wire nails down the flutes of the drill. With a pair of pliers, twist the nails in an anti-clockwise direction to remove the drill from the work. (J. M. Arncliffe, NSW.)

Furthermore, the suppression efficiency of resistors depends so much on the layout and circuit parameters of the ignition system that the amount by which they reduce the interference varies over very wide limits. Since the factors determining the magnitude of the interference and the efficiency of resistor suppression are complex and not easily assessed, it is impossible to do more than make such general observations.

Usually the amount of suppression obtained by resistors, whether the single resistor or with the addition of resistors at the sparking plugs, is greatest on vehicles giving high levels of interference. Any effect of moving the coil from the bulkhead or wing structure to the engine-block is likely to be most pronounced when there is a long cable between coil and distributor.

Often resistors at the sparking plugs are needed when there are long cables between the plugs and the distributor, but the converse is not necessarily true.

VEHICLES IN SERVICE

The problem for new vehicles is relatively simple, since the manufacturer can type-test his products either by acquiring suitable measuring equipment or by enlisting the services of organisations which have the necessary equipment and experience.

The problem of the vehicle already in service is much more difficult. The amount of work involved in type-testing every model on the road today is far beyond the capacity of the measuring and equipment and trained operators at present available.

Although Joseph Lucas and the Electrical Research Association have measured a large number of models, the number is only a small proportion of the total number on the roads.

The user of a vehicle already on the road cannot, therefore, be expected to act on any recommendation other than a specified method of suppression. For vehicles with coil ignition, the single resistor in the coil-distributor lead will reduce the interference in the television frequency band to the BS limit in about 60 pc of cases.

For a 6 db tolerance on the BS limit, that is, 100 microvolts per metre, the percentage would be increased to nearly 80. This is the simplest and cheapest method of suppression and, if generally adopted, would materially alleviate the television problem.

MORE THAN NECESSARY

The more complete type of suppression with the addition of resistors at the sparking plugs will give 100 pc effective suppression to the BS limit, but in some cases it would mean that more suppression resistors than are necessary would be used.

It would seem reasonable, therefore, to ask users of vehicles already on the road to fit the single resistor, with the proviso that, if in any particular case the interference is found to be appreciably in excess of the limit, then the user will be asked to fit, in addition, resistors to the sparking plugs.

A GUIDE TO TAPE DECK DESIGN

Following many requests, we are pleased to present an article which should be of special interest to those who may wish to build up their own tape deck. The first part, in this issue, covers the more general aspects. Next month our contributor suggests two or three ways in which successful decks can be constructed.

By P. D. THOMAS—PART ONE

BEFORE considering the mechanical details, a brief recapitulation of the tape and its properties will help the newcomer to visualise what is required of a tape-handling mechanism.

All the tape at present in general use has a standard width of one-quarter inch, within close limits which are usually specified by the manufacturer. The thickness varies slightly from one type to another, but .002in is about average, including the coating or emulsion of magnetic material.

There are many different types and makes of tape available; having slightly different characteristics: red oxide and black oxide; paper based and plastic based; high coercivity and low coercivity. Mainly the differences are noticed in the values of erase and bias currents for a given result, and in the playback level.

Although a recorder is designed to give optimum results with one particular tape, it is usually possible to use any other tape without adjusting the bias, &c., except where professional standards are aimed at. Therefore the tape deck should be able to handle all kinds of tape without obvious difficulty.

Table 1.

Tape speed	3¾	7½	11¼	15	in. per sec.
Playing time, 600ft	32	16	11	8	minutes.
Playing time 1200ft	64	32	22	16	minutes.
Frequency limit	4	8	12	16	Kc/s.

The reels most commonly used to hold tape are 7in and 5in diameter. These hold nominally 1200ft and 600ft of tape, respectively. A recorder should be able to use either size without difficulty, though a very compact unit could be designed to take 5in reels only.

Table 1 is a summary of the playing times for each reel at different standard speeds, with a typical upper frequency limit in each case.

The lightest possible material is desirable for the reels, such as plastic or aluminium, so that they will have low inertia, to make them easier to control when rewinding or running forward at high speed. An accident will then be less likely to break or strain the tape.

All reels have a standard spindle fitting—a central hole with three radial slots. This fits a bushing of appropriate size on the drive spindle; the hub of the reel rests on a collar or platform in which is set a pin or key, which engages with one of the slots to drive the reel. This is illustrated in Fig. 1, a cross-section showing the basis of a typical reel fitting.

It is desirable to clamp the reels to the spindles, but not essential unless the reels are mounted vertically. It prevents excessive rattling when running at high speeds, which will wear the hubs and may even damage them, apart from being annoying.

The larger the platforms, the smoother the run, and if they can be made about 2in diameter it will not normally be necessary to fix the reels. This is not always possible, however.

The reels can be clamped to the spindle by means of small screw caps of appropriate shape, having a short thread so that they can be quickly screwed on and off.

The first requirement of a tape mechanism is that it should pull the tape past the recording head or heads smoothly and continuously, at a given speed, without fuss or bother.

It is possible to drive the takeup reel at a constant speed and allow this to pull the tape past the head, but with a 7in reel the tape speed at the end of the run, with the reel full, would be four times that at the start (takeup reel empty).

Therefore, this method, though it might be used experimentally or for short runs, is not suitable for serious work, and a constant-velocity drive system is generally adopted.

A complete tape deck comprises: the full reel of tape, referred to as the rewind reel, and its drive; eras record and playback heads, in tha order; driving capstan and moto and takeup reel and drive.

Table 2.

Capstan r.p.m.	Tape velocity i.p.s. 3¾	7½	15
33	2.148	4.296	8.592
45	1.592	3.183	6.366
50	1.432	2.864	5.728
78	.918	1.836	3.672
100	.716	1.432	2.864
200	.358	.716	1.432
300	.239	.478	.956
400	.179	.358	.716
500	.143	.286	.572

The most important part of th mechanical system is the capsta This is an accurately-turned drun revolving very smoothly at a cor stant speed.

The tape either moves past it a tangent, in which case it is presse against the capstan surface by resilient roller; or it curves roun the capstan through 90 degrees more, maintaining its contact eithe by a roller or by friction.

In any case, the capstan gri the tape and forces it to move the same speed as that of its ow periphery, which, of course, is con stant, making the tape movemen independent of external forces, suc as friction of heads or guides, takeu torque, &c.

It is possible to dispense wit with the pressure roller if the cap stan diameter is sufficiently larg giving a large area to grip the tap In this case the capstan should b made of some fairly rough-texture material, rather than metal, to giv the maximum possible friction.

A steady torque must be applie to the takeup reel, which, combine with a certain amount of brakin on the other reel, or some othe form of drag on the tape, keeps th tape in close contact with the cap stan. In theory this is easy to ar range, and some commercial record ers use this system, which is simpl and effective when properly de signed.

DIAMETER RATIOS

However, there is one difficult The ratio of maximum to minimu diameter of the tape wound on a 7i reel is about 4:1.

Thus, if the takeup torque is ad justed so that the pull at the be ginning of the run is just enoug at the end of the run the pull wi only be about a quarter of this, an the tape will slip on the capsta But increasing the takeup torqu beyond a certain point will caus the take-up reel to run away wit the tape at the beginning of the ru when the pull will be too great.

Increasing the braking or drag o the tape will help, but the whol arrangement is a rather delicate com promise.

Adjusting the takeup torque a the reel fills, either manually o automatically, solves the problem; s does the use of a takeup reel wit a large minimum diameter.

The use of a plastic material fo the capstan, which tends to "stick" naturally to a plastic tape gives th best performance up to date, bu ch a material is not so readily ailable at present, as rubber and ier materials.

While considering the mechanism a whole, it is necessary to reember that the tape must be kept close contact with the face of the ad. No lateral or vertical moveent can be allowed.

This may be achieved by arrangg guides to keep the tape in posion and restrict its movement. Alrnatively, it is possible to use a essure pad, commonly of felt, on spring-loaded arm, to press the pe against the face of the head.

The latter method is very satisctory for contact, but wears the ad much faster than the former less the pressure is extremely ght. For this reason it is inadvisle to use the pressure pad as a rake, and, if no pressure roller is ed on the capstan, additional brakg should be provided on the reind reel or between this and the ads. Thus, the pad pressure should e no more than is necessary to aintain good tape-to-head contact.

XTRA OPERATION

The pad must naturally be moved ut of the way for threading the pe, or for rewinding or running st forward. This means further echanical complication.

The tape must be kept taut at all mes as it passes the heads if no ressure pad is used. The obvious ay to provide for this is to use me braking on the rewind reel.

The balance of the takeup torque nd braking should be so adjusted at the capstan tends to hold the pe back against the takeup pull the start, but supplies most of the ull against the braking at the end the run.

The effect of a capstan, which, ough it turns at a constant averge speed, does not run smoothly, is cause distortion of the signal reorded on the tape.

A very slight degree of uneveness in running, or vibration, or uddering, which would be unoticed or even undetectable in an rdinary machine, will be transmited by the capstan to the tape as microscopic jerking as it passes e head, and will be heard as disrtion of the recorded waveform.

The well-known problem of "wow" also present in tape recording and caused by eccentricity of the capan or its spindle, or a flywheel hich is not true, or a faulty govrnor if one is used.

OOD BEARINGS

The correct approach to these probems is to eliminate or minimise unven running as far as possible, by sing precision bearings and ballaces, correct lubrication, and accurtely turned and balanced spindles nd other component parts; then to ount a flywheel, as large and heavy possible, on the same spindle as e capstan.

A heavy flywheel will do a lot oward reducing wow and flutter here it already exists, in badly esigned and made drive systems, ut it is better to cure such faults the source than to try to cover em up.

Another cause of flutter is imperect contact between tape and capan, due to a badly-designed presure roller, or lack of one If an adequate flywheel is used, this is the most likely source of flutter. A more carefully made roller, or more suitable capstan material, will cure it.

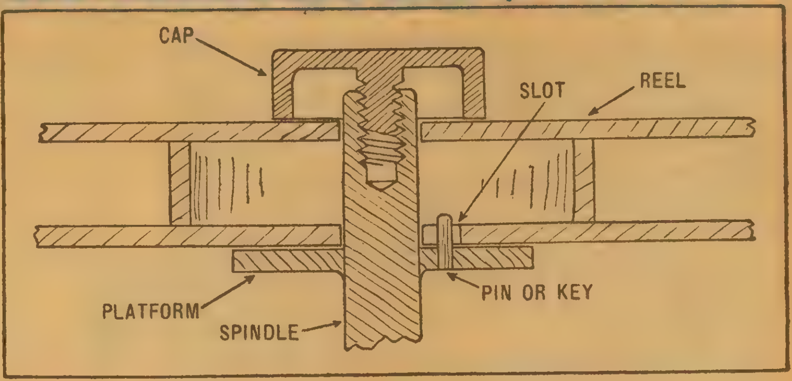


Figure 1: Cross section of a tape spool and mount, using a threaded locking cap. The cap may not be considered necessary if the reel mounts horizontally, and if more noisy fast winding can be tolerated.

The obvious choice of the experimenter seeking a ready-made drive unit for his capstan would be a standard turntable motor. This can give very good results, but a higher speed than 78 rpm is usually desirable, particularly in a compact layout, as a smaller flywheel can then be used.

If the turntable is used as a flywheel, it makes the layout bulky. The lower speed also calls for a larger capstan; although if the turntable is to be used as a flywheel, the capstan size will not matter.

If a suitable material is used for the capstan it may be possible to dispense with the pressure roller, provided the tape curves around at least 150 degrees of the capstan's circumference.

In the ordinary way, the best capstan size is between ½in and 1in. At 7½ ips, this requires a speed of between 150 and 300 rpm. The diameter is found from the formula:

$$\text{Capstan diameter (in)} = \frac{60 \times \text{tape velocity (ips)}}{\text{rpm} \times 3.1416}$$

For convenient reference, the capstan diameters at various speeds for three typical tape velocities are given in Table Two.

If the capstan drive unit is to be built from scratch, the following is a good basis for design: a four-pole induction motor with a bushing of suitable diameter drives a rubber-tyred idler wheel, which in turn drives the capstan shaft, on which is mounted a heavy flywheel.

CORRECT SPEED

The idler—one to two inches in diameter—should not be fixed, but mounted on a spring-loaded arm. The diameters of the motor bushing and the wheel or drum on the capstan shaft are chosen to give the appropriate speed reduction.

Thus, if the capstan speed required were 200 rpm, with a 1400 rpm motor, the reduction would have to be 7:1. If the bushing on the motor shaft were ¼in, then the wheel on the capstan shaft would be 1¾in diameter. This can be turned as part of the flywheel.

To change the tape speed, it is best

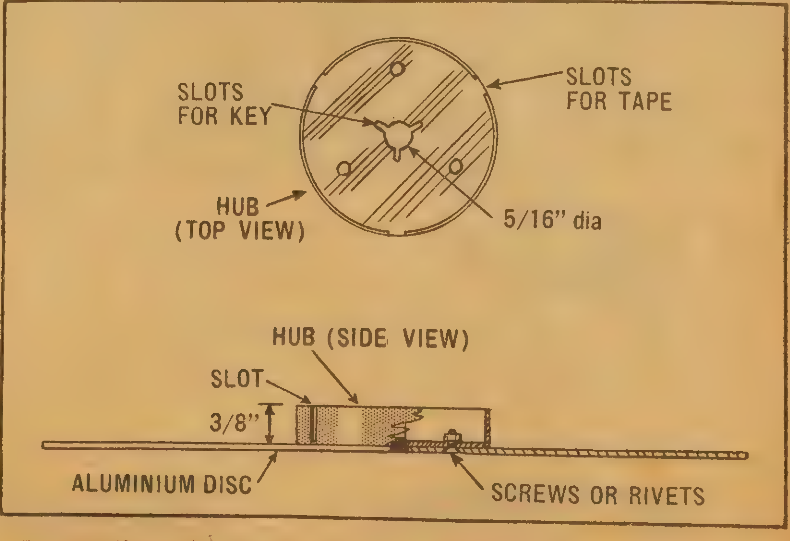


Figure 2: Showing how a single-sided spool can be made, ideal for easy tape handling when mounted horizontally.

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o change the motor bushing for one f different diameter.

The more obvious method of obaining the speed reduction, by means f gears, is not recommended, since ears introduce vibration which is ifficult to smooth out.

A belt drive, on the other hand, ; satisfactory if it is properly deigned, but a worn belt can cause a ot of trouble. Such a drive is often sed in professional equipment.

The only serious objection to the ubber-tyred idler is that it may evelop flats through being left tanding under pressure, but this can e prevented by avoiding excessive ressure, without losing efficiency.

The problem of keeping a steady orque on the takeup reel, so that he tape which has passed the heads nd capstan may be wound evenly nd tightly on to it, can be aproached from many angles.

CONVENIENCE

The merits of any particular sysem can best be judged from the spect of convenience, since, unless he capstan has no pressure roller, t makes no difference to the techical performance of the recorder whether the tape is wound with nathematical precision on to its reel r merely spills on to the floor.

As usual, the practical solution s something between the extremes. The two main systems are belt akeup and motor takeup, with either direct drive or a slipping clutch n each case.

Perhaps the simplest system uses n elastic belt, which can slip on its ulleys, allowing for the varying peed of the reel. This is so aranged that, with no slip, the reel vould turn at about 100 rpm (for ½ ips). When the reel is full, it will turn at about 20 rpm.

This works well, but has a rather xasperating disadvantage which ules it out for serious work, at east in its simple form. When it s required to run quickly forward, or example, to skip portions of a eel, the only short cut is to change ver the two reels and switch to ewind.

This in itself is not so difficult, ut in order to check that the reuired portion of the tape has been eached, it is necessary to change he reels back again. Thus, to hunt hrough a reel for some particular tem can become very tedious, and, vorse, can waste time.

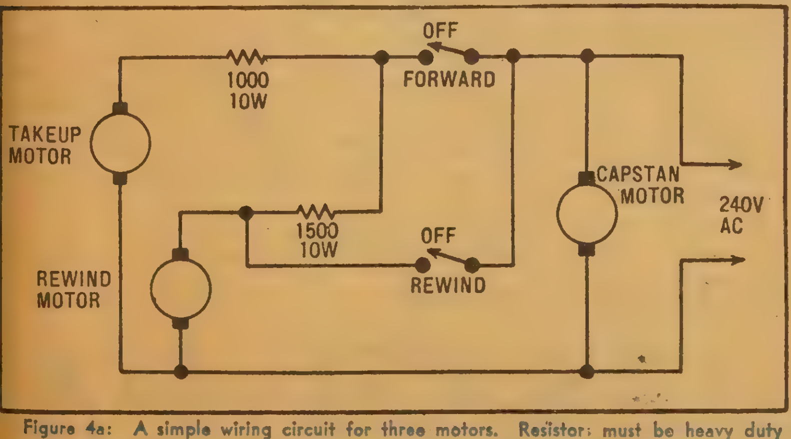

Figure 4a: A simple wiring circuit for three motors. Resistors must be heavy duty type, preferably with a sliding clip to permit adjustment of torque.

Most wire recorders suffer from this serious disadvantage, and those users of the older medium who have been caught out with a wanted recording on the wrong half of a reel of wire know how calamitous this could be.

The solution to the problem is to make provision for a fast forward run, which should average 10-20 times the normal running speed and be easy to control.

The simplest method of providing this seems at first glance to be the most extravagant, namely, the use of a separate motor for the takeup reel. If the reel is directly mounted on its spindle, this motor will be supplied with reduced power, just enough to wind the tape reasonably tightly, in normal running.

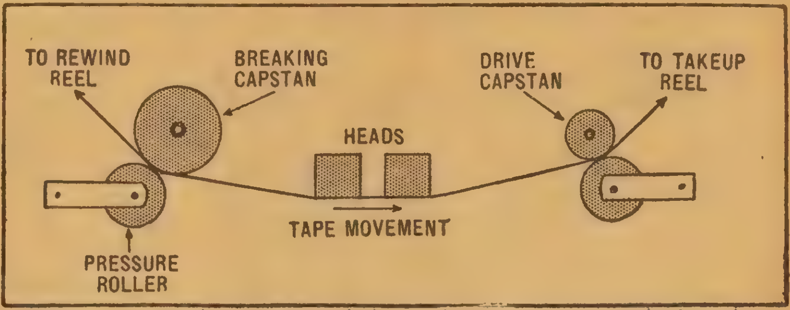

Figure 3: A typical arrangement which provides even pressure on the tape during the whole of its run. Simple reel braking, on the other hand, involves a wide variation in tape tension.

For the fast run, the full voltage is applied and the pressure roller, &c., is released to allow the tape free movement.

Ideally the tape should pass in a straight line from one reel to the other when it is running fast, but in practice it is not always possible or convenient to allow for this. Instead, its path should be arranged so that it encounters the least possible friction and it should not be allowed to press tightly against heads or capstan when it is moving at high speed.

Tape, which looks and feels so soft and weak, becomes a remarkably effective abrasive under these conditions, and in time it can cut through chrome plating.

If a four-pole induction motor is used for takeup (brush motors are not suitable) about three-quarters of the normal voltage can be applied for the normal run; that is, from 150 to 180 volts for a 240 volt motor.

With a well-designed motor this will not cause overheating even when it is forced almost to a standstill. If the motor becomes excessively hot and further ventilation is impossible it is better to reduce the voltage still further and tolerate a rather looser takeup wind.

The best way to obtain the reduced voltage is by means of an autotransformer. The power involved is very small, probably less than 10W and, rather than use another core, it is possible to use a tapping on the main power transformer primary if this can be specially wound.

It is not usually possible to tap an existing primary, but in some cases there may be room to add an extra winding.

Of course a separate transformer will serve very well, but it must be so mounted that it does not cause hum.

The alternative is to use a dropping resistor. This works fairly well, but it will dissipate up to 10W, and the extra heat must be disposed of.

To overcome problems of reducing speed or voltage a slipping clutch is often used. In a typical form the motor or belt drives a felt-covered plate, perhaps two or three inches in diameter, mounted on the main spindle, which revolves freely inside the reel.

FASTER FORWARD

A metal disc, which turns with the reel, bears against the felt, and the torque is thus transmitted to the reel.

There is at all times during normal running a considerable slip between the felt and the upper plate. However, if the tape is released from the restraint of pressure roller and guides the reel will be able to turn at the same speed as the spindle, and this will allow relatively fast forward running.

If the clutch is belt-driven, a spindle speed of about 300 rpm is a good compromise.

An advantage of this type of clutch is that as the reel fills up, its increasing weight presses the clutch plate closer against the felt and so provides the increase in torque required as the diameter increases.

It is important that a clutch should pull smoothly, without any shuddering or other defects. To achieve this it may be found, for example, that oiled felt is better than dry felt under some conditions. There is great scope for experiment along these lines.

Usually the same type of reel is used for takeup as that on which

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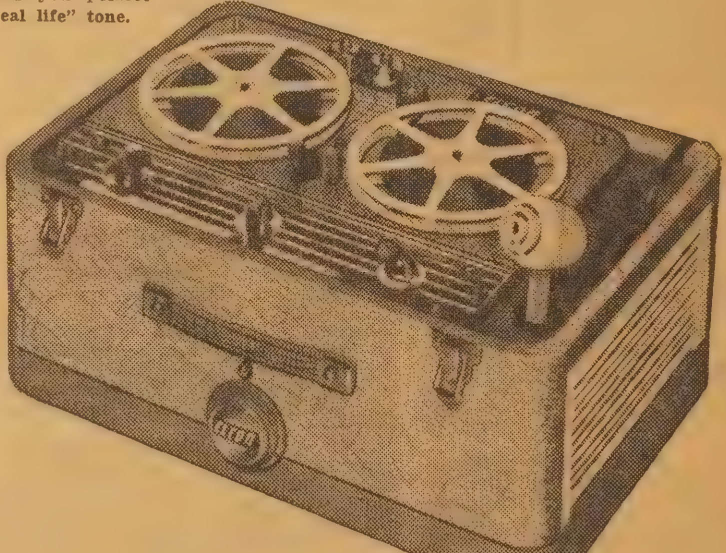

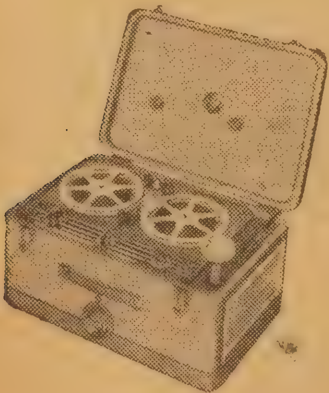

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e tape is stored but, where the take- rcel is not normally removed from e recorder, the tape can more ickly be threaded on an open or ub" type of reel.

This can be made very easily and is ll worth the effort. The materials quired are a disc of aluminium eet, just thick enough to be ade- ately rigid, not less than 7in dia- ter and preferably 7½in if this will the recorder, and a hub or cup least 1¾in diameter and 3-8in deep.

An old 2in diameter coil can, cut wn to 3-8in long, is suitable. The nstructional details are shown in g. 2.

The hub is bolted or riveted to the ntre of the disc with flush rivets or untersunk screws, after drilling a le 5-16in diameter in the exact ntre of each.

ADIAL SLOTS

With a fine rat-tail file make three dial slots to take the locking pin key of the same shape and size those on the standard reel. One ot would be sufficient, but slightly ss easy to position when fitting the el on the recorder. Finally, cut ree slots about 1-8in wide down the alls of the cup, spaced 120 degrees. To thread the tape, simply drop the d into one of these slots. To get better grip, drop it across any two ots with on inch or so of the end otruding; the first revolution of the el will fold this back neatly on the b and grip it tightly.

Round off any sharp edges or rners which may cut or tear the pe.

Facilities for rapidly rewinding the pe at the end of its run, though t essential to the operation of the corder, are very desirable—in fact, dispensable, if the recorder is to ve more than novelty value.

Since there is nothing critical about e speed, &c., of rewind, there is enty of room here for experiment, d any system may be used which ill allow the tape to be rewound ithout difficulty. The serious ex- rimenter will probably rule out nd-rewinding, though there are ses where this could be used.

If there is only one motor avail- le, this can be used for rewind by ranging a belt drive or gearing hich can be engaged or disengaged, required, with the spindle carrying e rewind reel. This will have to rn at between 500 and 1000 rpm.

Undoubtedly the best rewind sys- m from most points of view is to ount the rewind reel on the spindle its own motor, preferably an in- ction motor.

REFERRED MOTOR

The low starting torque of this pe is a distinct advantage here, as minimises snatching at the tape hen the motor is switched on. A pical four-pole motor will rewind complete 7in reel in about a minute, noothly and quietly.

When not being used for rewind, e motor provides a good pair of arings on which the reel can turn eely. Suitable motors are readily ailable. The only work necessary adapt them to use is to fit a simple atform to the spindle to carry the el. A discarded fan motor would satisfactory.

As in running fast forward, the pe should be freed as far as pos- ble from heads, guides, &c., for the wind run. Apart from the wear

ALTERNATIVE SWITCH WIRING

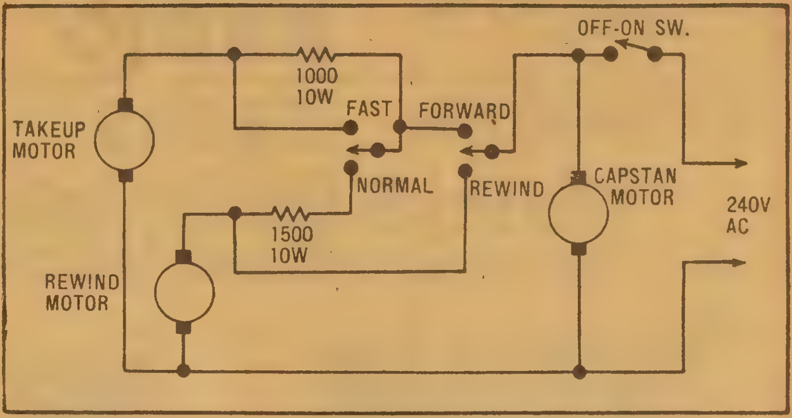

Figure 4b: An alternative method of arranging the tape control switches. There are many other possible arrangements, some tape decks incorporating all switching in the one multi-position control.

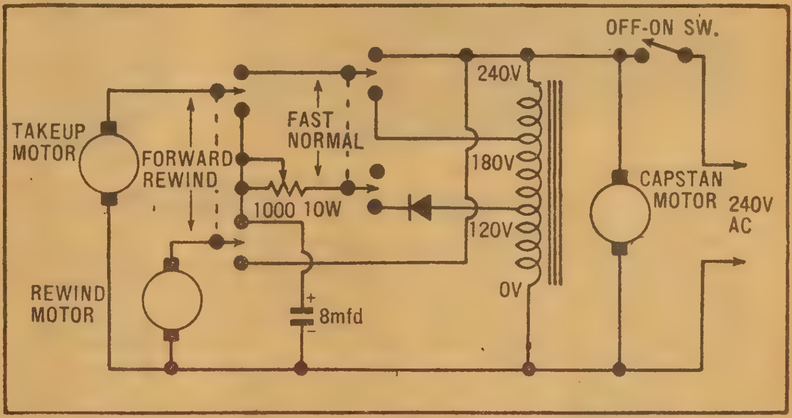

Figure 4c: A preferred system of switching using an auto transformer in place of series resistors. DC braking is also provided.

on these points, friction slows the tape to a remarkable degree.

If the tape path around the heads and capstan is fairly complex, it will probably be better to adopt the practice of lifting the tape completely clear, so that it moves straight across from reel to reel. This only takes a second, and it need only be done for a complete rewind run.

The amount of braking required, if any, depends upon the forms of drive used. If the head has no pressure pad, sufficient braking on the rewind reel will be necessary to keep the tape in good contact with the face of the head at all times.

The tape should curve slightly around the head, rather than pass it at a tangent; a change of direction of 10 degrees-20 degrees should be sufficient. More than this might be desirable, but it would probably bring the tape into contact with the head housing.

If a pad is used on the head, this will not apply. However, if the capstan has no pressure roller, a slight braking on the rewind reel is again necessary, in this case to pull the tape tightly against the capstan.

A brake on the rewind reel is also useful, if not essential, on a fast forward run, to control the speed and prevent the reels running amok when he power is switched off.

In the same way, a much better and more even rewind is obtained if the take-up reel is braked during rewind, and also the tape slows down toward the end of the run instead of speeding up.

There are several possible ways of applying braking. They may be classified as either mechanical or electrical. When the reels are driven by a belt or other mechanical means, the former will obviously have to be used.

A slipping belt or clutch can easily be arranged to perform this function automatically. Failing this, a simple friction brake will work very well. It must operate fairly smoothly, not in fits and starts.

DC BRAKING

Electrical braking requires the reel concerned to have its own induction motor. In the forward run, the rewind motor is not used. But, if a limited current is passed through it, it will act as a brake and pull back steadily on the tape. The strength of this pull can be adjusted by varying the current. A slight disadvantage is that, if it is given the chance, it will naturally pull the tape in the wrong direction.

This is a very simple arrangement, requiring only a series resistor or tapped transformer and the necessary switching, but a much better system is available.

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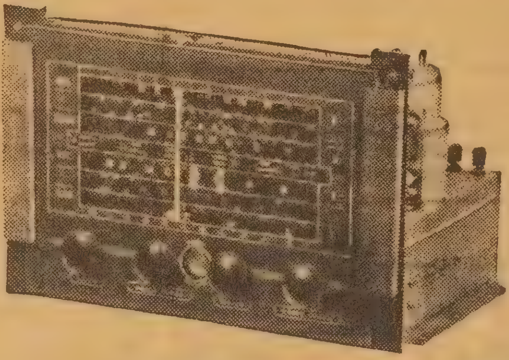

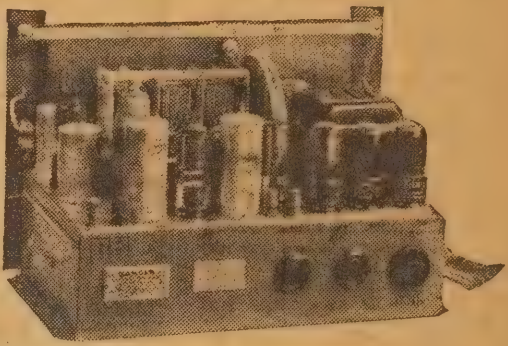

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indings, the field becomes a simple ectromagnet which grips the arma- re as tightly as is required. The sult is a perfect magnetic brake. is arrangement is ideal, and jus- ies the provision of separate reel otors.

The current required is usually of e order of 50-100mA., and may be tained either by connecting the otor in series with the amplifier HT ipply (double pole switching is ecessary) or from a special recti- er.

Fortunately the motor operates ually well on smoothed or un- noothed, half-wave, or full-wave irrent. Thus a single selenium rec- fier will suffice, though a valve uld be used, for example a 6X5 ith the anodes in parallel.

IMPLE FILTER

If smoothing is required, a single mfd electrolytic is ample. Since e DC resistance of a motor is uite low, about 500 ohms for most pes, not more than about 50 volts ill be needed if the current is noothed. The impedance to un- noothed, half-wave current is high- r, and in this case up to 100 volts ight be required.

An auto-transformer tapping at, ay, 100V would reduce the voltage ating of the rectifier and make the hole thing more efficient, but fail- ng this, a robust dropping resistor wire-wound) will limit the current the required value. This, or a ortion of it, must be adjustable so at the most effective braking cur- ent can be chosen.

In the case of the rewind run, the raking on the takeup reel can be djusted with a little patience so at it brings the tape almost to a tandstill with about half a dozen urns of tape left on this reel.

This is possible because as the iameter of the turns becomes smaller e braking effect becomes greater; that finally the torque of the re- ind reel is balanced by the braking ull of the other. This type of re- ind is simple and easy to handle, nd it would be difficult to devise better system.

It is not necessary to apply the rake to the reels themselves, though is usually convenient. For a fast un in either direction, it is most uitable. However in normal run- ing at constant speed, there is al- ays the disadvantage that the pull aries from start to finish of the eel.

ONSTANT TENSION

Neglecting any possibility of com- ensating for this automatically, it necessary either to strike a com- romise in the strength of the brak- g pull, or to make the braking rgely or wholly independent of e reels. This system may be called nstant-tension braking.

An elaborate method, but one hich demonstrates the principle, is own in Fig. 3. Here the constant- nsion brake takes the form of a cond capstan, with pressure roller, hich is driven by the tape instead driving it. This is mounted on simple shaft with a suitable brake, hich can be adjusted to give the quired tension.

A simple method of providing a rm of constant-tension braking, ossibly in conjunction with a slight raking on the rewind reel, is to ount two ball races, about ¼in. wide by ¾in. diameter, on the motor board, spaced perhaps 1in. between centres. If the tape is threaded around these in a fairly close S-bend, they will keep the tape taut enough for most purposes.

This arrangement complicates the tape threading slightly, but might be useful where a simple tensioning device is required.

In its simplest form, the motor switching will have to provide three positions: forward, rewind, and off.

This could be done with one three-position switch or with two switches, one being "off/forward", the other "off/rewind". Alternatively—perhaps a better arrangement—these could be "forward/rewind" and "on/off". This assumes that the forward run will be at normal speed, the rewind being fast.

Where the braking is electrical, it will be necessary at certain times to release the brake, for example in running fast forward or to complete the last few feet of the rewind run.

A push button, with normally closed contacts, is ideal for this purpose, as it eliminates the possibility of leaving the brake off by accident.

Where the reel drives or braking are mechanical, the switching will be mainly mechanical, and the details will naturally vary with the system used.

Assuming a recorder using four-pole motors for capstan, take-up and rewind, a very simple circuit uses two resistors and two on/off switches to provide the essential functions, including braking on both forward and rewind (Fig. 4a). The resistor values are typical, but can be varied to suit different motors.

NOT SWITCHED OFF

In this circuit the capstan motor runs continuously, to avoid using an extra switch section. However, as there is normally no reason to switch this motor on and off with the reel motors, the same arrangement might be used with the other circuits also.

A small pilot light could be wired across the power input, lest the power be left on when the recorder is not in use.

A more elaborate, but more flexible version is shown in Fig. 4b, where three switches give on/off, forward/rewind, and normal/fast operations. The main difference here is that in the "fast" position, the braking is removed in both directions, and in "fast forward" the full voltage is applied to the take-up motor also.

This is quite satisfactory in practice from the point of view of switching, and the braking works well enough in most cases. However, it is better to use an auto transformer to provide the reduced voltage and DC for braking.

Fig. 4c covers these points. Here the switching serves the same functions as before, but the "forward/rewind" and "fast/normal" switches are both d.p.d.t. types.

The auto transformer is tapped at 180 and 120 volts. The rectifier is a half-wave metal type rated at 200 V 100 mA., but if this is not available a valve rectifier could be used.

The 8 mfd. electrolytic smooths the ripple on the DC, which might be picked up by the head from the rewind motor when playing back. Its polarity must be observed. A voltmeter check will show which side of the circuit is positive if there is any doubt.

A semi-variable resistor of about 1000 ohms in series with the rectifier allows the braking current to be adjusted. The same value of current should be satisfactory for both forward and rewind braking. If more should be required for one than for the other, this resistor can be replaced by two of appropriate value, one going to each section of the switch, so that the currents for each motor can be adjusted separately.

The electrolytic will only be required across the rewind motor, so it will be connected to the resistor serving this motor.

HUM PROBLEM

If a separate auto transformer is used, it must be mounted as far as possible from the head, at an angle which induces the least hum into it. This can easily be checked by connecting up the transformer with long leads so that it can be moved about, with the playback head in circuit and playback gain at maximum.

Certain points will be found where the induced hum drops to minimum or disappears entirely.

Such a transformer can be wound very easily, if the materials are available. A 20-watt core is large enough, but of course a heavier one can be used. If the centre limb of the core is about one square inch in cross-sectional area, 2000 turns will be needed for a 240V supply, tapped at 1000 and 1500 turns. 32 s.w.g. or thicker wire is suitable.

If the centre limb is larger or smaller, the turns must be decreased or increased in inverse proportion. For example, if the area were one-half square inch, the number of turns would be doubled. The taps are still made at one-half and three-quarters of the total turns.

(To be continued)

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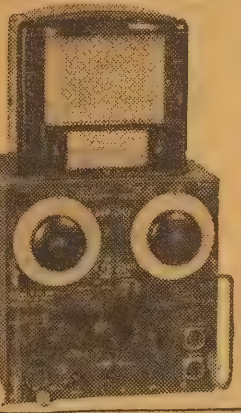

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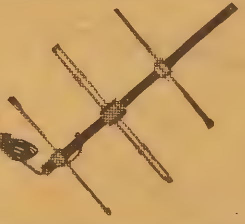

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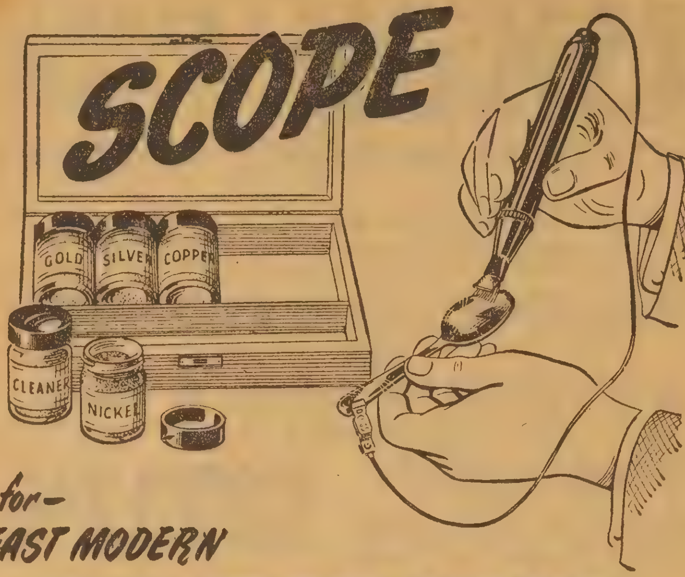

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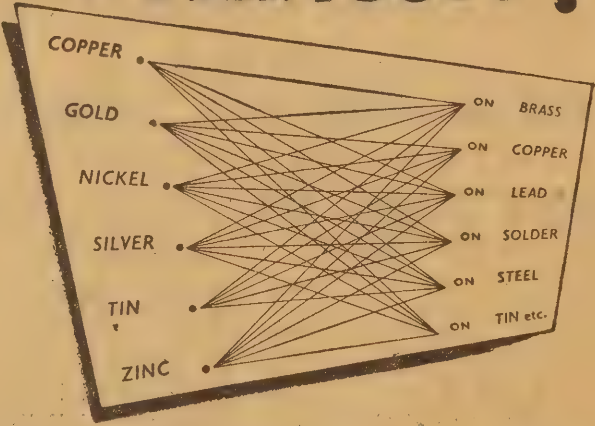

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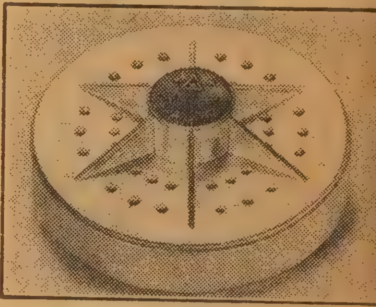
TWO MICROPHONES FROM ACOS

Two new microphones have been added to the Acos range, one a high quality crystal insert and the other a lapel microphone for general P.A. work.

THE insert designated as "Mic. 32 replaces in the catalogue th original and popular "Mic. 19".

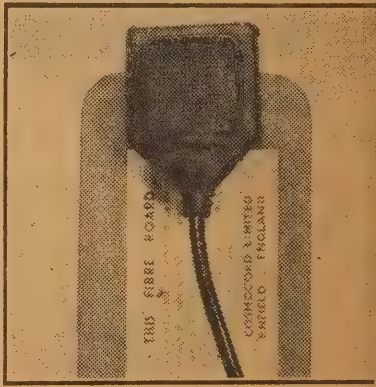
The new insert has virtually th same electrical characteristics bu employs a different method of co struction. In place of the origin sintercel front, the Mic. 32 has vaned die-cast front which



pierced with a pattern of tiny hole

Under a typical speech test th insert gave good crisp quality with out excessive peakiness. Respons claimed by the manufacturers is 30 7000 cps. Retail price quoted £2/15/6.

The lapel microphone, which also illustrated here, is speciall



designed for use on the public plat form, where the speaker require maximum freedom of movement.

The insert is moulded into a dar rubber case fitted with a sharp dres pin at the rear. To avoid undu strain on the clothing the microphon is supplied complete with a fibr board intended to slip into a pocket

Twenty feet of cable is supplie with the microphone, which shoul be adequate for most requirement

The microphone is essentially non directional, when used as intende and the response is adequate fo platform work.

Retail price for the lapel micro phone is £5/19/6.

Supplies of both types are avai able through major radio trad houses. Distributors are Messr Amplion (A'sia) Pty. Ltd., 88 Parra matta Rd., Camperdown, NSW.

TRADE REVIEWS AND RELEASES

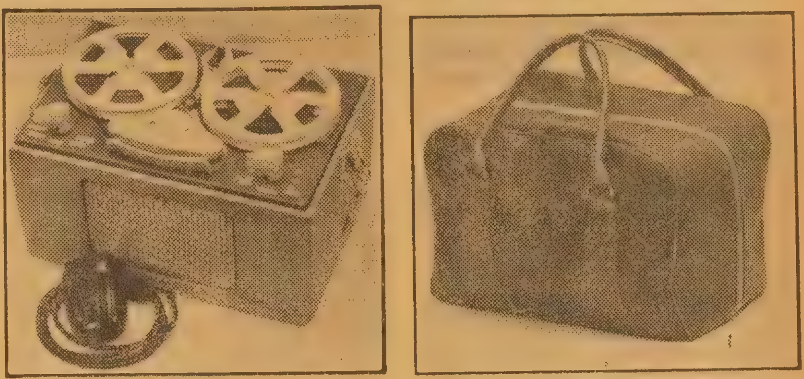
NEW BYER TAPE RECORDER IS LIGHT AND COMPACT

Something new in the tape recorder field has been produced by Byer Industries in their newly released Tape Recorder Type 55. It is probably not only the smallest available with full facilities, but also the lightest in weight as well. It sells for less than £100.

THE overall size of the recorder in its cabinet is 12 x 7¾ x 8in high, nd its total weight in carrying over, with microphone and tape, is 8lb.

Both these characteristics are nade possible by an exceptionally eat design, by the use of cast luminium for all metal work in he deck and chassis, and the use f a tape speed of 3¾in per second vith 5in reels. These reels carry 00ft of tape and allow the standard laying time of 30 minutes per reel.

Despite the slower speed, the reproduction is comparable with most ape recorders running at 7½in per econd, and is claimed to be comparable with that from an ordinary adio receiver. Under listening tests his claim would appear to be justified.



Two views of the new Byer recorder: On the left, ready for use, on the right housed in its zippered carrying bag.

The handy size and light weight of the recorder are the two features which are immediately impressive, in addition to the plastic, zippered carrying cover which has the appearance of an overnight bag rather than a technical instrument case.

When operating the recorder, the smoothness and positive action of the changeover switch is worthy of special note. Both fast rewind and fast forward speeds are provided, and it is possible to rock the control backward and forward at any speed with no apparent danger of breaking the tape.

This is due to the ingenious and well-made deck, based on a cast aluminium panel. The various drive wheels are also of cast aluminium, turned and machined to fit, with bonded neoprene tyres giving very smooth running.

Only one motor is used, a heavy duty synchronous type similar to that used for the well-known Byer disc turntables, and shielded against hum pickup. It has a powerful, smooth output without any discernable flutter or wow in use.

The recorder has a built-in loudspeaker—Rola 5B—with jacks for any high impedance input from radio or microphone, and for an external 2-ohm loudspeaker. It has two full-track heads, one for recording and one for erase with a high frequency oscillator.

THE AMPLIFIER

The record-playback amplifier has three stages using two 6AU6, one 6BJ5, and one 6X4 rectifier, and is wired on a cast aluminium chassis built around the drive motor. The chassis in turn is suspended from the top panel, so that the entire recorder may be withdrawn from the case as a unit.

A red, bezel type volume indicator is used, which flashes when the recorder reaches overload point. This indicator also serves to show when the recorder is switched for playback.

The top panel is finished in bronze enamel and ivory lacquer, the case in beige leatherette, the speaker grille in anodised aluminium, and the carry cover in tan PVC waterproof leather-cloth.

The Byer 55 gives the impression of being a well-engineered, true-to-label recorder which, because of its special features, should make quite a name for itself in the lower-priced field. It comes complete with a crystal type hand microphone and power cord.

CONNOISSEUR LIGHTWEIGHT P.U.

The English Super Lightweight Connoisseur pick-up submitted for test by J. H. Magrath & Co. Pty. Ltd., 208 Little Lonsdale St., Melbourne, is a well made unit both electrically and mechanically.

THE arm is finished in an attractive brown enamel, and appears o have no appreciable resonances which affect the pickup performance. Bearings are free and yet igid.

Two heads are supplied, one for tandard and one for microgroove. These are identified by the color of the small knob on the arm used for owering and removing the heads from the record. The heads are nterchangeable.

The 78 head is a little heavier than the microgroove, thus giving an automatic adjustment for stylus ressure.

The heads feature sapphire-ointed stylii which are easily re-laceable with the armature.

The head impedance of the model tested is 400 ohms and the output rather low, although not lower than comparable types. It will feed directly into the input of high-gain amplifiers at about 50 mV, although coupling transformers are available to step up the output if required.

Tested for frequency response and distortion using standard frequency records, the pick-up gave a high-grade performance. Noticeably absent were peaks on either range. On microgroove there is a broad rise of about 4 db at 10-12 Kc and a comparatively flat response to 14 Kc with no serious waveform distortion at any part of the range.

On 78 records the response was even better.

In use the pickup is clean and crisp, with a low surface noise on 78 records, and virtually none at all on good microgrooves. It tracks difficult discs without effort, and its good compliance should ensure low record wear. It is suitable for use with the highest-grade equipment.

The user price including tax is £12/6/-, spare heads £3/5/-, armatures 19/-, matching transformers £1/10/-.

OFF THE RECORD — NEWS & REVIEWS

Records are appearing on the market these days far too quickly for anyone to hear them all and earn a living at the same time. The LP record has certainly presented some marathon listening sessions for record reviewers. Of recent months, very few have been small items which were the backbone of the 78 market for many years.

By JOHN MOYLE

HOWEVER I have managed to hear some of the more important releases by several companies, and my comments herewith.

BEETHOVEN: Trio in B flat Major Opus 97 (Archduke) played by Jean Fourier (violin), Antonio Janigro (cello) and Paul Badura-Skoda (piano), Westminster WL5131.

This is one of Beethoven's' finest chamber works from a period when his absolute mastery of such things needs no comment. Many trios are liable to be unsatisfactory things—thin and unconvincing when attempting anything of weight and moment. But Beethoven here displays imagination and resources, both musical and technical, which can only be termed magnificent. This trio, despite its limited instrumental complement, has a stature just as great as we find in the piano sonatas and string quartets of this time. It is music which is never exhausted, demanding the highest degree of musicianship and performance.

The players are three men whose names are well known in Europe. Badura-Skoda has, of course, been heard in Australia. Their work here is good—they combine well and in general provide quite a distinguished performance. The second movement I liked particularly, although I have heard other sections dug a little more deeply by others. The Andante is a beautiful and extremely characteristic movement, reminiscent in spirit of many others not forgetting the Triple Concerto which some may remember was recorded some years ago.

The recording is full and forward although at times a little rough on the louder passages, particularly on wide range equipment. The piano, too, suffers from a somewhat wiry texture so often heard when recordings of some weight are attempted. But it is a beautiful record in many ways, despite these things. At times the violin and cello are remarkably vivid and convincing.

BOCCHERINI, HAYDN

BOCCHERINI: Symphony in A Major. HAYDN—Octet in F Major, played by the Vienna Symphony Orchestra and the Vienna Philharmonic Wind Group respectively. Westminster WL5002.

It is probable that more rarely heard works have been recorded in the microgroove era than at any other time. Both these titles come into that category and both are to be welcomed if for no other reason.

The Octet, written for two aboes, two clarinets, two bassoons and two horns, has been scored by Alexander Wunderer, according to the note on the jacket, as apparently various editions of the work did not agree. It is, as suggested, a goldmine for the woodwind virtuoso, and a fine example of woodwind color and combination. The playing is exceptionally well blended and competent—an object lesson to those who strive to produce music from a difficult group of instruments.

The music, typical of the period, is obviously written to display the accomplishments of the players, who do some astonishing things both with instrument range and technique.

The Boccherini Symphony is an attractive example of this highly significant composer, best known to the average listener through odd works and a famous minuet—a pity because his music, of which this symphony is an example, is worthy of a better fate. It has great charm and imagination, with more than a few things in common with greater music which was to come after it from other pens.

The recording here is clean and well defined, although the strings sound best with a little more top cu than is customary.

Balance is good, the performance lively and bright. Instruments are used freely, individually and in groups, and all are heard clearly with some particularly effective woodwind playing, very possibly from the same players who form the group heard in the Haydn Octet.

SLIGHTLY NOISY

It is a charming record whose only fault seems to be a rather crackly surface which, however, is reduced within bounds by some extra top cut. A little extra bass boost might als be in order, indicating perhaps response curve a little different from the standard, if there is still such thing.

RIMSKY - KORSAKOV — Symphonietta on Russian Themes DVORAK—Slavonic Rhapsody No. in G minor (Op. 45, No. 2), both played by the Vienna Symphony Orchestra, conducted by Henry Swoboda. Westminster, WL 5008.

To those familiar with the Rimsky-Korsakov of Scheherazade, this Symphonietta will surprise, for it i cast in a vastly different mould. Th first movement, a frank "Pastorale, is so reminiscent of Beethoven' Symphony that one wonders whether it was an intentional free us of a theme and even orchestral treatment. It's true that here and ther we can hear Scheherazade, but i general the approach is different, an orchestrally, quite interesting.

Another reminiscent melody whic threads through the second movement uses the theme exploited b Stravinsky in the Fire-bird suit Neither of these similarities shoul be taken as a slight on the music— if it comes to that, probably neithe

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of them is original, either to Beethoven or Stravinsky. Rather are they similar sentiments expressed differently by different people. Music has many similar examples for those interested enough to hunt them out.

On part of the second side is the Dvorak Slavonic Rhapsody, a typical work, and one of three in the Opus 45. It was from these rhapsodies that the much better-known Slavonic Dances grew, and this recording has much of their flavor.

Both recordings are good—of the same general quality as the Boccherini.

BEETHOVEN—Symphony No. 9 (Choral), played by the Vienna State Opera Orchestra conducted by Herman Scherchan—Symphony No. 1 in C major by the same combination. Westminster WAL 208.

I wonder how much has been written about the Ninth Symphony by those who would decry it, applaud it, dissect it and generally paw it about? If there were nothing else to make the name of Beethoven immortal, the riddle of this symphony would have done it.

Nothing can or could prevent musicians from diving into such a huge work, its score, its success, its failure. I often think many make a mistake in trying to line it up with any set form. Maybe it's that word "symphony" which sticks. It isn't really a symphony in the previously accepted sense of the word, and shouldn't be approached as though it were.

It is at once a major orchestral work and a choral work. There's nothing in the rules which say we can't have both. Let's find a new name for it, and maybe some of us will begin to see it from another angle.

Not being addicted much to choral works, I personally have always found the choral movement somewhat unsettling. Maybe it's because few performances are good enough to break through the sound barrier. But I can well understand those who are chorally-minded hailing it as a stroke of genius, an inspiration which may have come to many, but crystallised by no one else on such a scale.

GOOD RECORDING

It follows, therefore, that only a super recording and performance could produce a set of discs which pass all demands with praise. This Westminster recording takes plenty of marks, and I should say the general standard of playing is in line with many other fine works from the Vienna players. There are, in fact, some really striking passages. Few will fail to receive the impact of the drums in the Scherzo, or the adagio, probably as fine a movement as Beethoven ever wrote.

The last movement is a mixture of merit. There is some very good recording in it and some not so good. I've rarely heard clearer reproduction of the Turkish bit after the first vocal passage, where the triangle, cymbal and bass drum do their little piece. On the other hand, the choral singing collects some ragged lines under pressure, possibly through singing in too small a hall. The difficult task of balancing orchestra, choir and soloists doesn't seem to have been completely solved, and occasionally the sopranos seem unequal to their task, which I sometimes think is just too hard, anyhow. I wonder if it is really possible to avoid the general impression of mad scramble as this movement comes to an end? It's a pretty impressive end, too, and, although it gets a little rough and, understandably so, concludes with great verve.

This is the first of the microgroove Ninths I've heard so far, and its superiority over earlier versions, particularly through lack of interruptions, is most marked.

The addition of a well-played First Symphony on the fourth side of the two records makes this album good value. As with the Ninth, the orchestra has good presence, remarkably good dynamic range, and well-balanced instrument placing. Surfaces are fairly good, but clicks might show up on wide-range gear.

TCHAIKOWSKY—Symphony No. 4 in F Minor, played by the Vienna Philharmonic Orchestra, conducted by William Furtwangler. HMV ALP 1025.

This is a truly classical recording of an old trusty—a symphony for the millions if ever there was one. It has plenty of tuneful bars, tons of trumpets and brass galore, drama and romance. Most of us have thrilled about it at one time and another, and rightly, too, for it's what I call a rattling good symphony.

SERIOUS APPROACH

Furtwangler, however, doesn't rattle it anything like as much as I've heard done, but I doubt whether it suffers from that. There's plenty of permissible leeway with such a symphony. He sees it more seriously than many, and only in the last movement does the orchestra really let go, except for a strangely unimpressive opening chord, probably due to an apprehensive recording engineer cutting the gain too far in anticipation of an overcut groove.

Technically it's a fine record, and won't disappoint anyone. Despite some very heavy passages it is very clean, well balanced, and with a good dynamic range. It is a little remote rather than forward, but I prefer it that way. As a performance the standard is first rate. A few minor surface clicks on an otherwise good surface.

BRAHMS—Concerto in D major, for Violin and Orchestra, Opus 77, played by Isaac Stern and the Royal Philharmonic Orchestra, conducted by Beecham. Philips A 01106 L.

This is an auspicious release to mark the assault by Philips on the local LP record market which has just begun. This, perhaps the most beautiful of all violin concertos, is in distinguished hands, all of which have left their imprint upon it.

First of all, Isaac Stern, whom we have heard in Australia, is undoubtedly a violinist of the highest class. He has that aura of mastery about him which we associate only with fine performers, and his sure, sympathetic handling of the violin is in evidence from his first entry.

He gives a big, full-blooded demonstration, full of vitality and attack where required, yet firm in outline when the pressure is off.

Stern is quite definitely a modern violinist, with the ability to produce with great power and urgency. But in general the work is restrained, rather more so than I expected. I would have preferred a little more "hurry", particularly in the first movement, although if there is one thing Beecham will not be persuaded

(Continued on Page 103)

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SHORT-WAVE NOTES BY ART CUSHEN

REDUCED SCHEDULES FOR V.O.A.

The Voice of America, from June 30, is now on reduced schedule which is estimated to save the US Government £200,000 yearly.

REDUCTIONS in the Voice of America transmitters, due to the cancellation of contracts with five private broadcasting organisations, for 12 transmitters, has been effected by the US Government, states Broadcasting-Telecasting.

The stations affected are World Wide Broadcasting Corporation, Boston (WRUL), five transmitters, Associated Broadcasters, San Francisco (KWID), two transmitters; General Electric Company, San Francisco (KGEI), two transmitters; Crosley Broadcasting Corporation, Cincinnati (WLWO), two transmitters; and Westinghouse Electric Corporation, Boston (WBOS), one transmitter.

Though these US transmitters have been taken from service, the Voice of America is extending the scope of the relay stations, and is planning two new broadcast band relays in the Far East and one in the Eastern Mediterranean. One of the Far East stations, Manila-B, has been logged testing on 1140 kcs.

The other relays used by VOA include the floating transmitter ship Courier, at Rhodes, Munich, Germany, Salonika, Greece, which have both broadcast and short-wave delays, and the BBC transmitters at Wolferton, England. All these stations operate with an output from 150 to 300 kw, but Munich is expected shortly to operate on the boosted power of nearly 1000 kw.

It will, therefore, be seen that the VOA is still to be a major voice on short-wave and will still be using 30 short-wave transmitters, 16 of these owned by the US Government, six privately and eight jointly.

The Voice of America also operates RIAS (Radio in America Sector), Berlin, with both broadcast and short-wave transmitters. The main part of this transmitter's programs are for local German consumption, and are broadcasts mainly for the usual domestic listener.

Some time ago the US Government announced new short-wave transmitters would be constructed on the east and west coasts of the US for reception in specially-selected parts of the globe. These stations, which are of very high power, are also under construction, but further work on these two stations has been postponed in the meantime.

OTHER STATIONS

THE identification "Huna Kuwait" has recently been heard in New Zealand on 5000 kilocycles, when the station closed at 5 am, and from Radio Amateur we learn more of this interesting station, which, for several months, due to its purely Arabic programs, had the dxers in many countries guessing as to its identity.

The town of Kuwait lies at the north end of the Persian Gulf, 110 miles south of Basra. The station is under the direction of the Chief of Public Security, Sheikh Abdulla Mobarak, and all programs are in Arabic. The station operates 3-5 pm, 2.30-5 am, on 5000 kcs. The RCA transmitter is at present running at 1000 watts, but it is hoped to raise this to 5000 watts when further new equipment is installed. The aerial is untuned, slung on a 100ft mast in a north-south direction.

The station appreciates reports, which should be sent to the Broadcasting Officer, Radio Station, Security Department, Kuwait, Arabia.

Salonika, Greece, using a 35,000w transmitter, made its short-wave debut this month, and is at present operating on 6040 kcs., 3.45-7.45 am; 7270 kcs., midnight-7.45 am,

BANGKOK NOW 50 KW

With some jubilation, Radio Bangkok, Thailand, opened their new 50,000-watt transmitter in early July on 11,700 kcs. They use the transmitter which has the call sign HSK9 assigned, in the overseas broadcast from 8 to 10 pm. English is broadcast 8-9.15 pm, with news 8.15 pm. A second frequency, 6010 kcs., has also been announced as being in chain, Chinese is broadcast 9.15-9.30 pm and Malay 9.30-10 pm. The existing service 8-10 pm,, on the lower-powered station, is now deleted, the stations signing on at 9.30 pm with Home Service programs on 6240, 7140, 11,910, 15,410 kcs. The new Overseas transmitter is also expected to be used to Europe, 8-9 am, and USA 1-2 pm.

1000 BC VERIFS

During the last month your writer verified his 1000th broadcast band radio station. These thousand verifications came from radio stations in 58 countries, in the form of cards and letters confirming reception of their broadcasts as heard in New Zealand.

The verifications, in order of continents, were: North America (619), South America (3), Europe (44), Africa (4), Asia (82), Australasia (199) and Oceania (50). Radio listeners can see that, on broadcast, the world is at your fingertips. Unfortunately, the thrill of receiving Africa on broadcast band, though an event such as this is not unique, and the glamor of broadcast band dx, has been taken from the hobby by the ease with which these continents are received by short-wave listeners.

Nevertheless, the writer, now holding 1000 broadcast band, and 1600 short-wave verifications, holds a position unique in dx circles, as most listeners usually specialise in either broadcast or short-wave reception. It is understood that this is the first time a dxer is known to have 1000 verifications on both bands.

The most outstanding stations verified include Voice of the 8th Army, Italy, 750 watts; 5AL, Alice Springs, Northern Territory, 30 watts, and VUS, Shillong, India, 50 watts. Naturally, the log includes every Australian and New Zealand station verified.

DIGEST OF DX TIPS

Kcs.	Call and Location	Times Heard (AEST)
5980	Suva, Fiji.	3.30-8.00 pm.
7270	Stockholm, Sweden.	8.00-8.30 am in clear.
9520	OZF5, Copenhagen, Denmark.	English news noon.
9550	YSR, San Salvador, El Salvador.	Sign off 2.00 pm Sunday.
10070	4VSW, Port au Prince, Haiti.	Close 1.00 pm, English 12.25 pm.
11700	HSK9, Bangkok, Thailand.	News 8.15 pm.
11955	CR7BE Lourenco Marques, Mozambique	3.00-4.00 pm in English.

FLASHES FROM EVERYWHERE

RADIO HIRONDELLE, Hanoi, th
French Army Radio station, verifies b
letter from 63 Boul Doudard de Lagre
Hanoi. They state that power is no
400 watts, but will soon be increased t
1500 watts on 7405 kcs. Schedule
2-4.30 pm, 8.30-1 am. The station use
the slogan "La Voix de Forces de L'Unio
en Indochina du Nord".

RADIO GOA'S commercial service
operating on a new schedule, state
World Radio Handbook. Goa's schedul
is noon-3.30 am on 6025 kcs., 5000w, an
9610 kcs., 10,000w, while shortly furthe
broadcasts are expected to be made o
15,235, 17,795 and 21,685 kcs. The experi
mental broadcasts on 3452 kcs., usin
5000w, are still being continued.

NEW TIME SERVICE is now provide
by National Physical Laboratory, oper
ating stations MSF at Teddington, Middle
sex, England, who advise us that the
are now operating 24 hours each da
on 2500, 5000 and 10,000 kcs. MSF, lik
WWV in Washington, DC, USA, operate
a time, and frequency check service
and was heard here some months ag
at good strength, when using 10,000w
Power has now been reduced to 500
and reports are appreciated.

NOTES for the next issue close at
212 Earn Street, Invercargill, NZ
on August 8th. All times mentioned
are Eastern Australian Time.

MSF schedule for the hour is mad
up of: 0 to 5 minutes, 1000 cycle tone
5-10min 1sec pulse; 10-14 minutes signa
unmodulated, 14-15 minute, speech an
nouncement, and the transmission con
tinues the same for each quarter-hou
period, except at 15 to 20 minutes pas
the hour, no transmission takes place, s
that WWV's signal can be heard withou
interference. MSF's main purpose is t
extend the coverage of WWV's service

LATEST SWISS SCHEDULE of th
Swiss Broadcasting Corporation, Bern
is to hand, and as Mr. K. B. Wallace
of Gympie, Queensland, requested infor
mation on these stations, we are print
ing the present schedule.

To Eastern Australia and New Zea
land, 5.15-7 pm on HER5 (11,865), HER
(15,305), HER7 (17,784). To Western Aus
tralia, 7-7.45 pm on the same trans
mitters. The Swiss North American ser
vice is also well received during qu
afternoons, and this transmission is
two parts, from 11.30 am-1.15 pm an
1.15-2 pm. The transmitters used ar
the same for both services, HER3 (6165
HE13 (7210), HER4 (9535), HEU3 (9665
HER5 (11,865). Dancing in Switzerlan
with Lance Tschannen, is presented
the Pacific transmission on Friday
5.35 pm, Requestfully Yours wtih Lanc
and Isobel, Mondays, 6 pm, and th
Swiss DX session is released the fir
Wednesday in each month, edited b
Russell Henderson, at 5.35 pm and 7.
pm. Russell Henderson's World Yout
Magazine, on Sunday at 5.45 pm, contain
interesting news of youth activitie
throughout the world, and has a speci
pen-friends corner. Pen-friends are ex
changed free of charge. The address
the Swiss Broadcasting Corporation
23 Neuengasse, Berne, Switzerland.

4VEH 10,000 WATTS

4VEH in Cap Haitian, Haiti, is short
to increase power to 10,000 watts, whe
the new transmitter, under constructio
takes the air. New frequencies in th
60, 49 and 19 or 16 metre bands, are als
to be used. The present transmitter
3000w and commenced operation in Jun
1950. They use three 125ft steel tower
for the antenna system.

THE HAM BANDS WITH BILL MOORE

REMEMBRANCE DAY CONTEST SET FOR MID-AUGUST

The Remembrance Day contest is the best supported of the events conducted by the WIA and annually many amateurs who served during World War II meet up with service friends. The contest serves to commemorate their comrades who made the supreme sacrifice.

ANNUALLY the Wireless Institute of Australia conducts the Remembrance ay contest on the weekend nearest the nniversary of VP Day, August 15. It is eld to perpetuate the memory of Aus- ralian radio amateurs who gave their ves for their country during World War I, and whose names are engraved on the rophy awarded to the division of the WIA ompiling the highest score.

Amateurs are especially invited to par- icipate in this contest. The following are e rules:

1. The contest will commence at 1800 ours EAST on August 15, and continue ntil 1759 hours on August 16.

2. The contest is open to all Australian mateurs, but only members of the WIA re eligible for awards.

3. The contest is an open event—CW, hone, or a combination of each may be sed.

4. The contest is an interstate one, nd amateurs in each State will endeavor o contact amateurs in all other States.

5. A station may be operated by more han one operator under his own call ign, provided each operator enters a sep- rate log.

6. All existing amateur bands may be sed, and all transmissions must conform ith the regulations as laid down in the MG's Handbook for the Guidance of perators of Amateur Wireless Stations. ny breaches of these will lead to the isqualification of the operator concerned.

7. The arrangement of schedules for ontacts on other bands will not be per- itted.

8. All stations entering the contest will all "CQ RD", if using CW, and "CQ emembrance Day", if using phone.

9. A State competing for the trophy ust submit a minimum of six (6) logs om financial members before becoming ligible for the trophy.

10. Only one contact per station per band permitted.

ERIAL NUMBERS

11. Serial numbers to be exchanged dur- g the contest will be as follow:—

(a) For CW, the first three figures will be the RST (Telegraphy) report, followed by the serial number of the contact commencing with any number between 001 and 100 for the first contact, and increasing in value by one (1) for each successive contact. If any contestant reaches 999, he will then commence 001 and continue 002, &c.

(b) For phone, the first two figures will be the RS (Telephony) report, followed by the serial number of contact commencing at any number between 001 and 100, and continuing in a similar manner to the CW serial number.

A complete exchange of serial numbers must take place before any points may be claimed for the contact.

Scoring: In order that an equitable distribution of points for States with a large number of contestants compared with a State with fewer contestants may be determined, a sliding scale of points has been allotted, as shown in the scoring table appended.

13. In addition to the points in the scor- table that may be scored by a con- stant, a bonus of 25 points may be add- d for each State worked on 50 mc and ove.

Logs:—The log submitted must show in e following order: Date and time, band, nission, call sign, RST/No sent, RST/No ceived, points claimed. No log will be cepted unless laid out in this order.

15. A statement signed by the operator ust be attached at the conclusion of the g stating that the regulations (Rule 6) d these rules have been observed. Any logs departing from this form will automatically be disqualified.

16. All logs must be forwarded through the Contestants Divisional Council (for membership checking) to reach the Federal Contest Committee, Box 1734, GPO, Sydney, on or before September 12, 1953.

Awards:—Attractive certificates will be awarded to the first, second and third highest in each State; there will be no outright winner for Australia. Where a large number of logs are received from any one State, further certificates may be awarded at the discretion of the contest committee.

Trophy:—The State to which the perpetual trophy will be awarded shall be determined as follows.—

To the average of the top six (6) logs shall be added a bonus arrived at by multiplying this average by the ratio of valid logs submitted by that State, to the total of amateur licencees in the division at the time of the contest.

19. The logs which will be accepted for the multiplier under Rule 18 shall show at least five (5) contacts in the contest.

20. The trophy shall be forwarded to the winning State in its container and will be held by the State for a period of twelve (12) months, when the winner for the succeeding year is determined.

21. The Federal Contest Committee shall be the sole adjudicators, and their ruling will be binding in the case of any dispute.

SCORING:

Contacts from VK2 to VK3—1 point, VK2 to VK4—2 points, VK2 to VK5—3 points, to VK6—5, VK7—4, VK9—6.

VK3 to VK2—1, VK4—3, VK5—2, VK6—6, 5, VK7—4, VK9—6.

VK7—4, VK9—6.

VK4 to VK2—1, VK3—2, VK5—3, VK6—6, VK7—5, VK9—4.

VK5 to VK2—2, VK3—1, VK4—3, VK6—5, VK7—4, VK9—6.

VK6 to VK2—1, VK3—2, VK4—4, VK5—3, VK7—5, VK9—6.

VK7 to VK2—2, VK3—1, VK4—4, VK5—3, VK6—5, VK9—6.

VK9 to VK2—1, VK3—2, VK4—3, VK5—4, VK6—5, VK7—6.

Although not finalised at this date, it would appear that VK1 stations on Macquarie, Heard and Cocos Islands will be invited to join in the contest.

As they would not be operating on behalf of any division of the WIA, their scores could not count toward the trophy. However, certificates could be awarded to such stations.

Due publicity will be given over WIA official broadcasts covering the change and points available for contacts.

INTERNATIONAL AMATEUR CONGRESS

The third International Amateur Radio Union Congress was held at Lausanne, Switzerland, during May. Previous congresses were held in Paris in 1925 and 1950.

ON the last two occasions delegates were present from European societies, and thus represented Region 1 (Europe and Africa). It was decided in 1950 that congresses would be held every three years, to discuss matters affecting amateur radio.

This year's congress was in session for three days, and after an opening plenary gathering of the full congress, was divided into two sections—Administrative and Technical.

Each society represented was permitted to elect two delegates to each sectional meeting. A final plenary session was held at the end of the congress, and after its completion, amateurs in attendance were entertained at a hamfest conducted by the host society, the Swiss National Society, the USKA.

Some of the pertinent questions discussed by the Administrative section were as follow:—

1. A suggestion that the RSGB National Field Day should become part of a larger International Field Day.

2. The desirability of setting up an International Emergency Network.

3. The co-relation of contests to minimise their number.

4. The international exchange of portable facilities, i.e., to discuss the possibility of nations in Western Europe offering limited facilities to properly-licensed amateurs for portable operation during holidays. To be arranged on a reciprocal basis.

5. The European Band Plan (a plan to allocate CW and telephony segments on the various amateur bands on a voluntary basis). Unrestricted telephony operation in Europe causes considerable QRM, especially as a percentage of phone signals emanating from the Continent are of poor quality.

6. Ways and means of combating "interlopers" into the "exclusively" amateur bands.

7. The best manner of co-ordinating the efforts of Region 1 societies in the retention of the amateur bands, and the method by which these societies can ensure the goodwill of its own administration, so amateur radio will be effectively supported at ITU conferences.

The Technical Committee discussed, among other subjects, operating standards, TVI problems, amateur television, UHF propagation and micro-wave development, single sideband transmissions, &c.

The final decisions of the congress have not been published, but the meeting should be of great benefit to societies in Region 1, and will undoubtedly iron-out problems besetting amateur radio, as only meetings of this character can do.

The International Amateur Radio Union now comprises 49 national societies throughout the world. 23 of these societies are located in Europe and Africa (Region 1), 19 in the Americas (Region 2) and seven in Asia and Australasia (Region 3). The boundaries of the regions are as set out at the Atlantic City Telecommunications Conference.

In Australasia, the Wireless Institute of Australia officially represents amateurs in this country, while the New Zealand Amateur Transmitters' League represents amateurs in New Zealand.

During last year seven new national societies were elected to the IARU. They represented amateurs in the following countries: Bermuda, Ecuador, Germany, Mozambique, Netherland Antilles, Southern Rhodesia and Yugoslavia.

Since the inception of the union, the ARRL has been the headquarters society, while the RSGB acts as a central bureau in Region 1.

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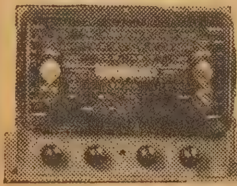

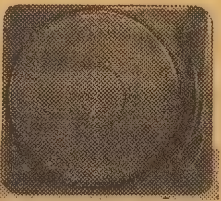

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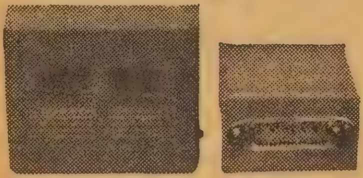

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NEW LICENCES

DURING the last two years due publicity has been given to the WAI's intention to request the Postmaster-General's Department to consider issuing Novice and Technical classes of licences.

There appeared to be no serious objection to the idea by the average amateur. Since the announcement in "Amateur Radio," that the PMG's Department would issue Technical class licences, some comparatively violent comment has been heard on the air on the virtues of this class of licence.

Discussion mainly centred on the point that no Morse requirement was to be incorporated in the licence. It seemed to be accepted by many that Morse could be taught to domestic animals, so why should it not be incorporated?

If present AOPC holders had to contend with such a requirement, it should be common to all classes of licences.

Others pointed out that, quite often due to poor conditions, Morse provides the only form of communication possible, and such a contingency could and has arisen during emergency working.

While the proposed new class of licence does alleviate the problems of learning Morse, a number of other factors should be considered. This class of licence would introduce fully-qualified technicians into amateur radio and these operators can do much to assist in the opening of the UHF frequency bands, the only section of the spectrum in which they will be permitted to operate. Their geographic location often should close up gaps in the various UHF links in the more sparsely-populated sections of the country. There, too, is no reason, provided they become sufficiently interested, why they should not gain their AOCP's and gravitate to the lower bands. Perhaps with a sunspot maxima and improved propagation conditions, there will be something to attract them.

They should give added impetus to the hobby which, at the moment, if the additions and deletions of stations are followed, has reached a static level from a population viewpoint. Most amateurs will welcome to the ranks the serious-minded technicians or engineers who will spend most of their spare time on experiment.

UHF FIELD DAY

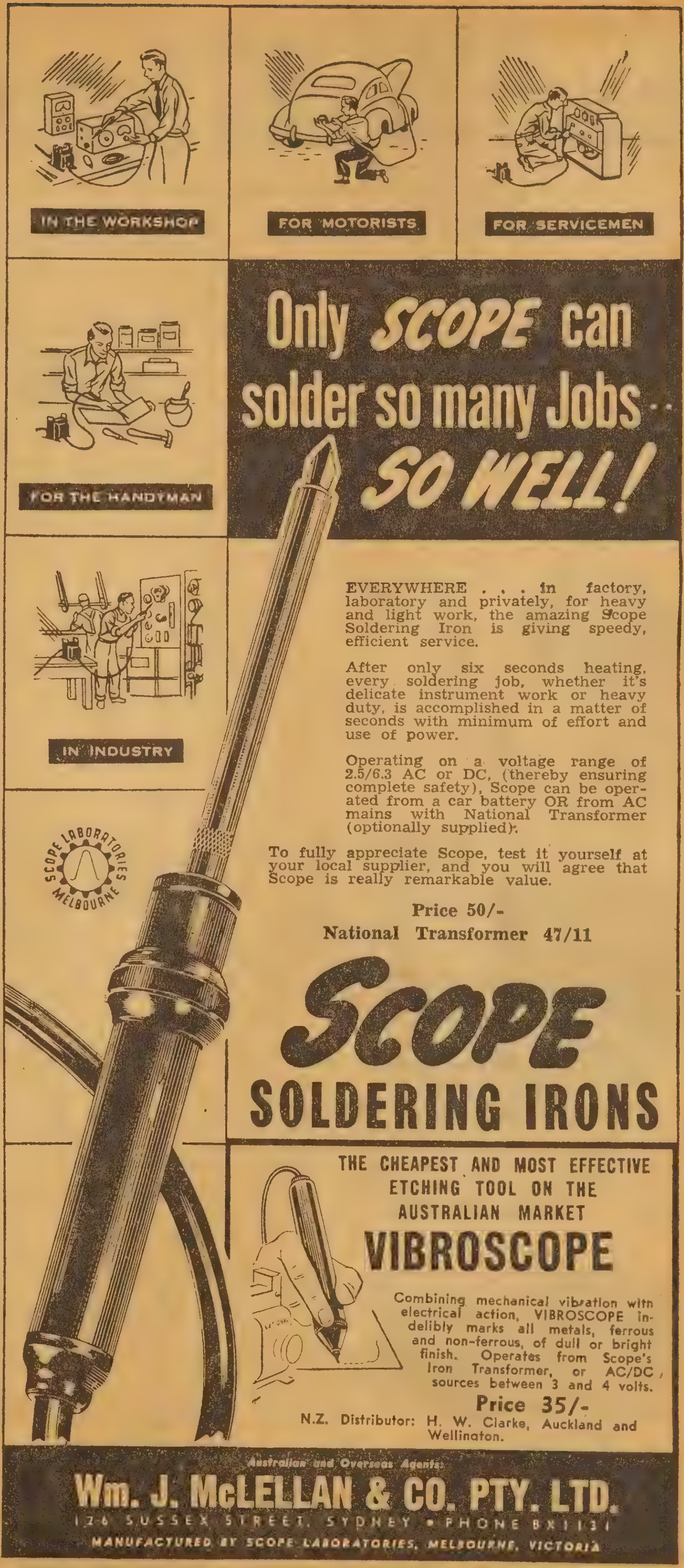
THE NSW UHF section conducted on July 26 a novel and successful 144Mc field day. It took the form of a hidden transmitter search, but for most of the transmitting period the station was mobile. The transmitting party, comprising VK2ANF, VK2ARX, and Es Griffiths, left the home QTH at 9.30 am to proceed to the selected final location. On the trip they transmitted every 15 minutes from various points on the route, one of these on a detour to confuse the searchers. The final venue, some 27 miles from their departure point, was reached at 11.30 am, and from then onwards a continuous transmission was made. The first party to reach this location was Keith Alcock, VK2AOA, 15 minutes later. One hour later Leo, VK2KS, and Jack, VK2AGT, arrived to fill second place. A special award is to be made to Alf, VK2CE, who homed on the many transmissions from the radio centre, Pennant Hills. During the afternoon a one-hour scramble was conducted on 144Mc, eight portable stations participating.

The NSW UHF VK2WI broadcasts are made each Sunday at 2000 hrs EAST. The transmission is made by UHF section secretary, Harry Solomons, VK2AJZ, on 144Mc and relayed in turn on 50Mc by VK2HE, VK2QZ and VK2ANF.

YOUR OPPORTUNITY

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.



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SURVEY OF RADAR TECHNIQUES

(Continued from Page 51)

the electrons are reflected into th cavity in the right phase to sustai oscillations.

The average velocity electron ma take $\frac{3}{4}$, $1\frac{3}{4}$, $2\frac{3}{4}$ or $3\frac{3}{4}$ RF cycles in th "drift space" between the cavity an reflector, and still return in th right phase.

Electronic tuning by varying th repeller voltage is important for rada receivers since it allows the use c a system of automatic frequency control to keep the receiver tuned t the frequency of the transmitter i spite of variations due to therma drift or load impedance changes.

AFC CIRCUIT

The parts of a representative AF circuit are shown as dotted lines i Fig. 1. It consists of an extra crysta mixer and IF strip, which sample th transmitted signal and apply it to frequency discriminator.

If the transmitter frequency varies, the discriminator develops a error voltage which is applie through appropriate control circuitr to the repeller of the klystron. Th local oscillator is thus automaticall retuned to the transmitter frequenc as long as it remains within the klystron's range of electronic tuning.

The remaining circuits of the rada receiver, that is, the IF and video amplifiers and the second detector, ar quite similar to those encountered i television practice.

Most of the gain of a typical rada receiver, which is usually about 12 db, is obtained from the IF amplifier, which may consist of as man as ten stages. The selectivity of th receiver is also determined by th band-pass of the IF amplifier.

Since the spectrum width of th transmitted signal is considerable fo the transmission of very short pulse the IF band-width must usually b several megacycles.

A figure sometimes used by system designers for receiver banc width is 1.6/t, where t is th transmitter pulse duration in microseconds. To obtain such band-width double-tuned or stagger-tuned I stages are employed.

TYPICAL STAGE

A typical single-tuned radar I amplifier stage is shown in Fig. Such stages depend upon high G tubes like he 6AK5 or the 6AC for high gain-bandwidth product The resemblance to conventiona television IF stages (minus the soun traps) is evident.

Since the crystal detector contributes no gain, the noise characteristics of the first IF stage ar very important in determining th overall noise figure of the receive For this reason, much work has bee devoted to the development of low noise IF input stages.

Special low-noise triode circui such as the cascode amplifier ar widely used in radar practice. (Fro The Aerovox Research Worker.)

PHOTOMETERS SAVE TIME, MONEY

If one were to ask the average photographer which aspect of photography he disliked the most the answer would almost certainly be, "Making test strips in the enlarger." There have been many attempts to overcome this problem by the use of light measuring instruments—or photometers—and this article discusses the various types and their characteristics.

by Philip Watson

THERE is little doubt that most photographers regard the making of test strips as a most unpleasnt chore, and it is not difficult o appreciate why. For one thing t involves the use of paper and, f the strip is to be of any real value, it must be a reasonable size elative to the finished print. Thus sheet of paper won't go very ar, and the process represents a definite outlay.

Even more objectionable is the ime factor. For the test to be worthwhile, it is considered desirable to make at least three exposures, ideally locating the centre one as close to the correct exposure as possible. This alone requires certain amount of time, involving he unwrapping of paper, the cuting of the required strips, rewrapping the paper, and making the exposures. Then several more minutes are required to develop, fix even briefly), and examine for the best strip.

For the enthusiast who does a imited amount of work it is not unusual for the first set of strips to be only partly successful.

It may be that the shortest or ongest exposure looks the best of he three, but suggests that it is till not optimum. Again, it may be that they are so far out that hey merely indicate the general rder of the correction needed. In ither case a second test is necesary, if one is to be sure that the ight exposure has been found.

"JUDGING" THE LIGHT

It is not much wonder, therefore, hat many amateurs attempt to skip his important phase of their enarging and attempt to "judge" the alue of the projected image. Someimes they come reasonably close o the mark, but, for the most part, he exposure error is so great that he development has to be either eriously curtailed or prolonged in n effort to save the print.

Either way, the quality of the rint will suffer and it is frequently ecessary to make a second one, hus completely nullifying the attempt to save time and paper.

It may be some consolation to the mateur to learn that the profesional photographer is not so very much better off. Certainly his exerience enables him to judge the ght valve better than the amateur (who can usually only indulge in is hobby at odd intervals), but, ven so, he still produces a high ercentage of waste prints.

The fact that this does not apear to worry the professional is ue mainly to the fact that the icture has such a high commerial value, compared with the cost f a sheet of paper, that the wastge is not serious. Nevertheless, it does emphasise that "judging" the exposure is an almost hopeless task when we consider the small margin of error which is permissible.

All this naturally brings us to the question as to whether any mechanical or electronic device is capable of measuring the light and thus produce a foolproof method of making enlargements. Up to a point it is possible to answer yes to this question, though it may be more accurate to say that the best we can hope to do is eliminate the major portion of the guesswork. It is doubtful whether any device will ever completely replace the test strip for the very finest work.

Before considering the various approaches to the problem, it may be best to examine the characteristics which an ideal version of such a device would be required to have.

Firstly it should operate in the focal plane of the projected image, in other words on the baseboard, where the paper will eventually be placed. This is to enable it to take into account the effect of differing degrees of enlargement on the available light.

The next point, and one of the most important, is that it should measure the smallest possible area of the image. This is because we need to know the exact value of light in individual parts of the image, rather than the amount of light transmitted by the negative as a whole.

Unless we are able to do this our readings will be confused by a factor in which we have no interest, namely, the proportion of thin and dense areas within the negative.

A practical example may help to make this clear. Assume that one picture is taken against a more or less neutral background and consists of six girls in white tennis frocks and one in dark clothing. Immediately after this, and under identical lighting and exposure conditions, a second picture is taken consisting of six girls in dark clothing and one in a white tennis frock.

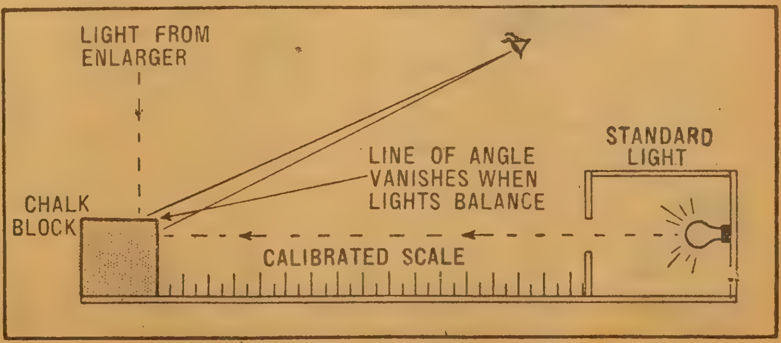
Now it is fairly obvious that the amount of light which each negative would transmit would be quite different, the one with the six white-clad figures transmitting less because more of the negative area would be relatively dense. Yet, it is equally obvious that each negative would require exactly the same printing exposure since the density range in each would be exactly the same.

SERIOUS LIMITATION

Thus, a device which measures the total amount of light which the negative transmits, or so large an area of the image that it includes several tones, will be subject to considerable error, and this is where many devices fail.

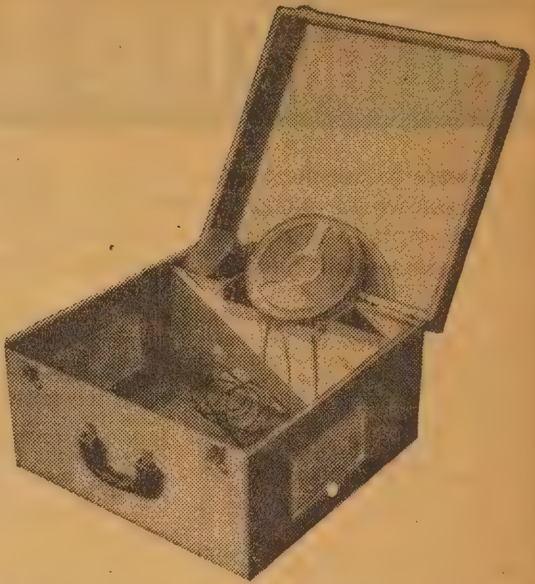
In making a print we should aim at an exposure which will produce a faint, almost indiscernible, veil of silver to represent the brightest highlight, selecting a grade or contrast of paper which will then cause the shadow portions to print as nearly as possible to a pure black in the darkest portions, but with all lighter tones preserved.

How close we come to this de-



The basic principles of a chalk block photometer. The two lights to be matched are compared on the two faces of the chalk block, the line of angle vanishing when both lights are equal. Balance of light color is most important.

IN A *CASE* LIKE THIS YOU CAN EXPECT THE *BEST!*



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THE MODEL 15 TAPE RECORDER CAN BE OBTAINED THROUGH THE FOLLOWING

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NICHOLLS SOUNDCRAFT PTY. LTD. 141 SPENCER RD., CREMORNE, N.S.W.

AEGIS EXTENSION SPEAKERS PROVE THAT . . .

"It costs so little to enjoy RADIO in any room!"

The new Aegis Extension Speakers are the latest means of enjoying radio in every room. You can choose from two attractive styles that blend pleasantly with modern and period furniture. There are Aegis distributors in all States . . . so ask to see the new Aegis Extension Speakers at your Aegis dealer's store.

SP1: Attractive circular moulded cabinet, contrasting feet, louvred grille front and rear. Complete with 6in speaker less transformer (3.7 ohms impedance). Terminal block supplied. Colours: Pastel blue, green and pink, black, walnut and natural (off white).

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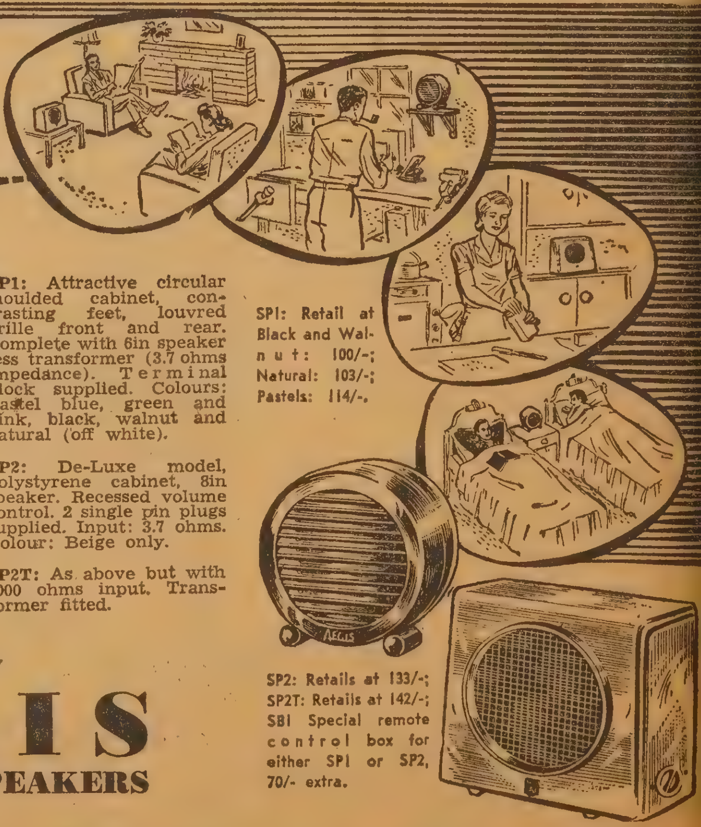
SP2T: As above but with 5000 ohms input. Transformer fitted.



SP1: Retail at Black and Walnut: 100/-; Natural: 103/-; Pastels: 114/-.

SP2: Retails at 133/-; SP2T: Retails at 142/-; SB1 Special remote control box for either SP1 or SP2, 70/- extra.

AEGIS

THE NEW AEGIS EXTENSION SPEAKERS

AEGIS MFG. CO. PTY. LTD., 208 LITTLE LONSDALE STREET, MELBOURNE, C4414

ls on a number of factors, in-
ing the development of the
tive, but the point is that the
t highlight is our reference
t.

nis brings us to the next re-
ement of our photometer: It
ld be sensitive enough to mea-
the image produced by the
est portion of the negative. As-
ing that we can do this, it is
y obvious that we cannot only
rmine the exposure required for
ven negative, but also the range
ones it contains, and thus the
e of paper most nearly suited
.

nere are other characteristics
ch our device should possess,
as ease of working, mainten-
of accuracy, scales which per-
adjustment for various grades
aper, &c., but these are refine-
ts and present no real difficulty.

Y WEAK LIGHT

hat does represent a difficulty
tisfying the three main require-
ts because the amount of light
ent on the baseboard, over a
ully small area, and in the dark-
portion of the image, is very
ll indeed, and calls for a very
itive device to measure it.

or is the problem one of sim-
increasing the brilliance of the
ge because, apart from the
blem created by heat when we use
tantially larger lamps, the image
ld then be so bright as to re-
e exposures of only a fraction
second and which cannot be
d accurately. As most amateurs
w, the average negative at nor-
degrees of enlargement will re-
e a small lens opening if the
osure time is not to be incon?
iently short, say in the order of
cond or less.

ome of the slower papers, such
he chloro-bromide types, by re-
ing a brighter image for the
e exposure time, might be a help
orderline cases, but cannot alter
position significantly.

t first glance the problem ap-
s to be an ideal one for an
tronic device, involving photo-
s and the like, but in practice
is not so. The main difficulty
imply one of providing the re-
ed sensitivity, and the ordinary
ocell and microamp meter com-
ation, as used for exposure
ers, is nowhere near sensitive
gh.

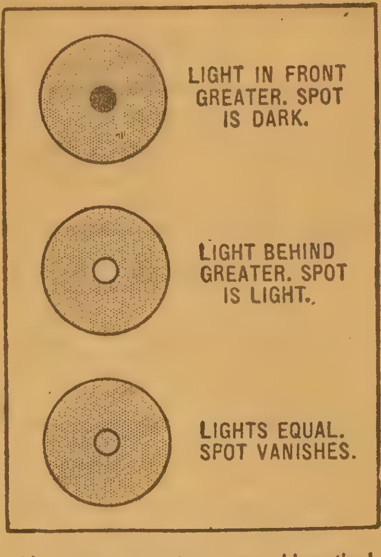
NG A METER

ome attempt has been made to
the ordinary exposure meter as
enlarging photometer by simply
nting it in front of the enlarger
so that it intercepts all the
t passing through the negative.
arrangement will usually pro-
enough light to operate the
er, but the value of the reading
ery doubtful. For one thing, it
not take into account the de-
of enlargement involved, and
user is expected to introduce this
or by subsequent calculation.

ven assuming that this can be
e accurately (which is not as
as it may appear), there still
ains the major objection that
negative is being viewed as a
le rather than being analysed in
ll areas. The idea is useful where
e may be several negatives of
same subject but having differ-
densities and which require to
compared. This condition occurs in the making of separation negatives in various color printing processes.

An amplifier interposed between the photocell and the meter would certainly help, but there are difficulties here, too, because the energy to be amplified is DC and the design of DC amplifiers is not simple when more than one stage is required.

The use of vacuum or gas type photocells, as distinct from the barrier layer types just discussed, appears to offer some advantages but, at the same time, also introduces fresh problems. One is the high impedance of the cell and the problem of leakage across the base and socket when very low values of current and high amplification are involved.


LIGHT IN FRONT GREATER. SPOT IS DARK.
LIGHT BEHIND GREATER. SPOT IS LIGHT.
LIGHTS EQUAL. SPOT VANISHES.

The grease spot is a very old method of comparing light values and the above drawing gives an idea of the effect observed. As with the chalk block, balance of light color is important and some systems of light control fail in this respect.

Another is the physical construction of the cell, which makes it difficult to place the sensitive surface exactly in the focal plane and also to mask it so that only the required area will be analysed.

A better proposition appears to be the use of a phototube multiplier which is capable of providing amplification within itself to the order of many thousands of times, and this overcomes most of the electrical problems at least.

What might be termed the ultimate in such devices is one wherein the output from the cell is made to control a timing circuit so that the enlarger is automatically turned off when the paper has received sufficient exposure. Whether such a degree of control is necessary, or even desirable, is open to question, but the idea is at least interesting.

AN EASIER WAY?

Unfortunately we are now getting into the region of high cost and complexity, and although this does not completely rule the idea out, it does suggest that simpler ideas should be examined first.

This brings us to a consideration of the non-electronic or visual type photometer. The idea behind these photometers is not by any means new, having been used in laboratories for many years before the introduction of practical photocells. They have the advantage that they are suitable for measuring low levels of illumination with quite a high degree of accuracy and, furthermore, in a form suitable for photographic work, they can be made for a very low cost.

In all forms the general principle is the same, namely, that of comparing the light to be measured with a light of known intensity, or "standard" light. Generally the standard light can be varied according to a calibrated scale and is adjusted until it exactly matches the unknown light. Since the two may now be regarded as equal, the value of the unknown light may be read directly from the calibrated scale.

The actual means of comparing the light is key to the whole idea, and the two methods most commonly used are the "grease spot" and the "chalk block".

THE GREASE SPOT

The grease spot works on the principle that a spot of grease on (or rather in) a piece of paper will appear darker than the surrounding paper surface when the light behind the paper is less than in front, but will appear lighter when the light behind is greater than that in front.

Most important is the fact that when the two lights exactly balance, the spot will completely vanish.

This is the condition which is aimed at when adjusting the device, and the adjustment required to produce it is quite critical and does not normally require any great degree of skill. However, there is a limit of light value, below which readings are difficult, simply because the eye has difficulty in differentiating between the spot and its surroundings.

There are several ways in which the value of the standard light may be varied. The most obvious is to vary the current through the lamp by means of a variable resistor, and this has the advantage of simplicity. However, it has the very real disadvantage that the color of the standard light is varied at the same time, becoming more red as the current is reduced.

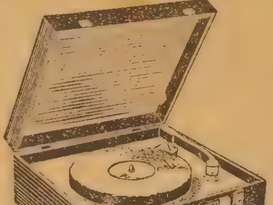
This makes accurate reading difficult because it is only possible to make the spot vanish if the two lights are identical in color.

BLUE FILTER

It has been suggested that this difficulty can be overcome at least sufficiently for our purpose, by filtering out the red rays with a blue filter, and, although the proportion of red and blue rays is not constant, it does appear that the suggestion may be worth while. At the moment we are carrying out some experiments which we hope to publish next month.

Other methods of varying the light are by use of an adjustable diaphragm or iris, by neutral density filters, or by varying the distance between the light and the comparison spot.

The use of a diaphragm is a good idea except that such devices are not usually available to the amateur. The neutral density filters do not provide a continuous variation in light, which is really essential in order to obtain a perfect match, but



RECORD PLAYER

This record player uses a well-known brand of English electric motor and a good English Magnetic pick-up. The unit has a 2-pin socket for AC connection and shielded lead pick-up. It is extremely light in weight and is beautifully finished in Brown, or Black leather cloth.

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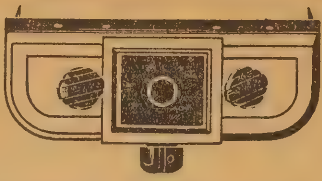
Weight 13lb.



REMOTE CONTROL FOR CAR RADIO

Consists of a bakelite underdash mounting dial with tuning volume and tone control knobs. Square glass scale marked in Kilocycles from 550 to 1600 KC and also two flexible remote control cables approximately 2ft long could be adapted to any car radio.

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For the radio repair man, amateur experimenter, motor mechanic and electrician. This pocket size multimeter is ideal. DC Voltage readings 0-15, 0-150, 0-300, 0-600.

Ohms scale:—0-10,000 ohms. The di is exceptionally easy to read and th meter will stand up to any amoun of hard work.

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All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.

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6. **0-50 mA Meters**—Brand new English meters, boxed and perfect. Square Dial, 2" Scale. Ideal for multimeters, etc. Worth £3/10/-. Our price 18/6.
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16. .01 1000 volt Wkg Tubular Bakelite Encased Mica Condensers. Worth 7/11. Our price 2/3 each.

SPECIALS!

17. 5000, 7000, 10,000 ohm small Speaker Transformers, suitable for Portable Radios and small mantel sets, etc. A type to suit any valve, match 3in and 5in Rola, etc. Worth 16/-. Our price 6/6 each.
18. 2 mfd 500 volt Wkg Electrolytics. Tubular Pigtail type. 1/- each.
19. 50 mfd 12 volt Wkg Electrolytics. Tubular pigtail type. 1/- each.
20. 6-pin Plug and Socket. Will carry fairly heavy current. Type SC166A. 2/- pair.
21. .0002 1500 volt Wkg Mica Condenser, pigtail connections. Worth 2/6. Our price 1/-.
22. .1 plus .1 plus .01 2250v Test Tubular Paper Condensers. 1/- each.
23. .005-1000v Wkg Tubular Condensers with pigtail connections. Worth 1/6. Our price 9d each.
24. **Knobs.** Black Indicator Knobs as used in AT5, AR8 equipment. Pointer Type 1/6. Key Type 1/-.
25. BC732A Radio Control Boxes in aluminium box size 3 x 2 5/8 x 2 inches with 1 phone jack, 1 N.P Toggle S.P. Switch, 1 Bradley Carbon Pot with indicator knob, 1 6-pole Rotary Switch and 14-pin Socket. Worth 25/-. Our price 7/6 each.
26. BC631B Jack Boxes, housed in aluminium box 3¾ x 2¼ x 2 inches, with 6-way heavy duty terminal strip and 10,000 ohm Carbon Pot and control knob. 2/6 each.
27. BC958A (CWS-23ABG) Power Control Box and BC965A Selector Control Box combined. Power Control Box size, 6 x 3 5/8 x 2 inches. Selector Control Box size, 4½ x 2¼ x 1¾ inches. Each pr. units contains 1 Phone Jack, 2 Cutler Hammer N.P. Toggle Switches, 1 5-pin Heavy Duty Plug and Socket and 1 7-pin Heavy Duty Plug and Socket, 1 6-position Wafer Switch with Pointer Knob. Well worth 25/-. Our price is 6/6 ea.

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25 ohm	20 watt	2/6 eac
50 ohm	10 ,,	2/- eac
100 ,,	40 ,,	4/- eac
50 ,,	85 ,,	5/- eac
450 ,,	10 ,,	2/- eac
2500 ,,	10 ,,	2/- eac
3500 ,,	10 ,,	2/- eac
10,000 ,,	10 ,,	2/- eac
700 ,,	20 ,,	2/6 eac
850 ,,	20 ,,	2/6 eac
5000 ,,	20 ,,	2/6 eac
1000 ,,	20 ,,	2/6 eac
12,500 ,,	20 ,,	2/6 eac
250 ,,	20 ,,	2/6 eac
4000 ,,	20 ,,	2/6 eac
15,000 ,,	30 ,,	2/6 eac
15,000 ,,	25 ,,	2/6 eac
5000 ,,	27 ,,	2/6 eac
3750 ,,	30 ,,	2/6 eac
1000 ,,	40 ,,	4/- eac
5000 ,,	55 ,,	4/- eac
300 ,,	85 ,,	5/- eac
1000 ,,	85 ,,	5/- eac
2500 ,,	85 ,,	5/- eac

10,000 ohm tapped at 3000 ohm. 55 wat 5/- each. 350 ohm 25 watt with adjustable tap 3/- each.

29. **10 Core Cable.** All rubber insulate suitable for currents up to 4 amp in perfect condition. 1/9 yd.
30. **Heavy Twin Cable.** Each core i rubber insulated and has 7 strand 22 gauge Copper Wire. Outer insula tion of water-proofed woven cot ton. 1/- yd.
31. **Outdoor Aerial Wire,** with water proof insulation. 50ft. 3/6, 100ft 5/
32. **Spaghetti Tubing,** in 1 yard length 2, 2½, 3mm, 6d length; 4, 5mm 9 length; 7, 10, 12mm 1/- length; 1 20, 22, 27mm 1/6 length.
33. **Job line Sapphire Needles.** Britis made, will play 2000 records. Traile type fit any standard pick-up. Usua price, 13/9; our price 7/9.

MOTOR SPARES LTD.

547 ELIZABETH ST.
Melbourne

BRANCHES THROUGHOUT VICTORIA AND RIVERINA

are sometimes useful in pro-
ig a rough adjustment of the
to bring it to the same gen-
order as that being measured.

rying the distance appears to
one of the most satisfactory
mes, though it does mean that
mechanical construction of the
ce is somewhat more exacting.
e is another slight objection and
is that it becomes more bulky
when, say, a variable resistor is
, due to the distance over which
ight must be varied in order to
ide sufficient range.

CHALK BLOCK

e chalk block system works on
principle of comparing the light
ng on two adjacent surfaces.
e are normally set at approxi-
ly 90 degrees and consist of
two faces of a block of chalk
h have been ground flat and
oth, so that the edge forming
angle is sharply defined.

e unknown light is shone on to
surface and the standard light
o the other, the standard light
g adjusted until the two sur-
s are equally illuminated. This
asily determined by observing
line formed by the junction of
two surfaces, which will dis-
ar when the lights are balanced.

with the grease spot, this con-
n is quite complete and very
cal, providing the color of the
lights is the same. The need
balance the color of the two
s cannot be too strongly em-
ised, and much of the success
ese schemes depends upon it.

e same methods of varying the
dard light as used for the grease
may, in general, be applied to
chalk block, though most de-
s seem to favor the variable dis-
e method.

their very simplest form either
hese schemes could use a fixed
e of standard light, the light
ected from the enlarger being
ed by means of the diaphragm
l a balance is obtained, the re-
nt exposure time always being
same.

hile interesting as an experi-
t, it will usually be found that
range of control provided by the
hragm is insufficient to cope
the combined variation of nega-
densities and degrees of en-
ement.

addition, there is no easy means
mparing the light and dark areas
he image to determine contrast.

HER VARIABLES

egardless of the type of photo-
er used, it is important to realise
there are some variables which
difficult to allow for. One of
e is the speed of the paper,
h, although close, is never quite
same from batch to batch. This
mean that some tests may have
e made whenever the number
he paper packet indicates that
contents come from a new batch,
rrection factor being applied if
ssary, until that batch is finish-

nother variable is the line volt-
supplying the enlarger lamp.
ough at first glance it may ap-
that any variation in light from
cause would show up in the
surement of the projected image,
is not quite correct. In addi-
to reducing the light a reduc-
in voltage also changes the
, making it more red and less
ic.

The photometer cannot easily interpret this change unless it is one of the electronic variety and the cell is made to have the same spectral response as the paper.

Yet another variable is that of timing, and this can be serious when attempts are made to give very short exposures. Any time less than five seconds is regarded as risky and less than two as quite unsuitable for manual timing.

Summing up, one may say that an electronic device, sensitive enough to fulfil all the requirements listed, would be a very desirable piece of equipment, but that it may well prove too costly and complicated for the amateur.

VISUAL TYPES CHEAP

The visual types of photometers, on the other hand, are simple and may cost next to nothing to make. Admittedly, they may not be as accurate as our theoretical electronic gadget, but, at the worst, they will indicate the general order of the exposure and enable a more useful set of tests to be made.

In most cases they will do much more than this and enable large numbers of prints to be made without the need for tests.

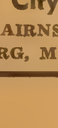
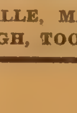
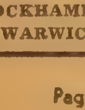
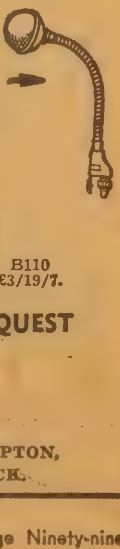
STORAGE TUBE

(Continued from Page 21)

The tube makes it possible to "extract" a single frame from a television program and store it for future reference. This frame may be transmitted over a normal high quality telephone line by scanning it at a very much lower rate and storing the impulses on another similar tube at the other end, eventually to be transmitted as a still picture at the normal television scan rate.

In this way a complete frame may be transmitted every 10 seconds and enables a series of still pictures to be reproduced at the distant point together with an appropriate commentary. In many cases this would provide an excellent emergency coverage for an important event.

Another use is to produce a usable picture from a channel having a high noise level. Since the interference flecks are a random effect they will not be the same for successive frames and so do not build up a strong pattern on the storage mesh. The wanted signals, on the other hand, will reinforce each other with successive frames where no movement is involved, eventually over-riding the noise signals. (Electronics, March, 1953.)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- PARTY USE WITH YOUR HOME RADIO

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NEW!

The A.W.A. RONETTE models R572/L and RFC/L with inbuilt transformer for use into low impedance long lines.

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RFC/L £19/-/-.

S742 £16/3/6

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0-10 amp meters, AC-DC, 2¼in dial	45/-
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Weston 0-50 volt 0-100 amps combined M/coil,	£3/10/-
English 50-0-50 Ammeters, M/coil	37/6
English 20-0-20 Ammeters, M/coil	37/6
English 0-20 Voltmeters, M/coil	25/-
English 0-300 AC-DC Voltmeters	55/-
English 0-5 Milliammeters, 2¼in	27/6
English 0-150 Milliammeters, 2¼in	30/-
English 0-25 Ammeters, 2½in, M/c	30/-
English 0-10 Ammeters, 2¼in dial, Moving Coil	45/-
English 0-30 Voltmeters, 2½in Dial AC-DC	42/-
Eng. 0-40 Ammeters, 2¼ dial AC-DC	42/-
English 0-50 Ammeters, AC-DC	42/-
Eng. 0-3 Ammeters 2¼ dial, AC-DC	45/-
Eng. 0-5 Ammeters 2¼ dial, AC-DC	45/-
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil	39/6
Eng. 0-500 Micro Ammeter M/coil	37/6
Eng. 0-150 Ammeters, 3½in Dial, AC-DC ..	75/-
Eng. 0-50 volts, 3½in Dial, AC-DC	75/-
Eng. 0-20 amps, 2in Dial, M/c	25/-
Eng. 0-1½ Milliamps, 2in Dial, M/c	19/6
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FIT ONE TO YOUR CAR OR TRUCK.

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The name of Elgin is world renowned and made by the best manufacturer in America.

GENUINE AMERICAN KLAXON HAND OPERATED HORNS

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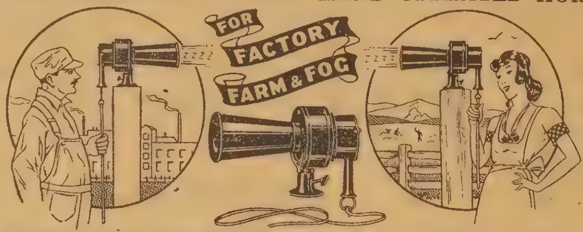

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BRAND NEW LEVER TYPE GREASE GUNS.

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Ideal for all types of trucks, tractors or cars. 7500lb pressure.

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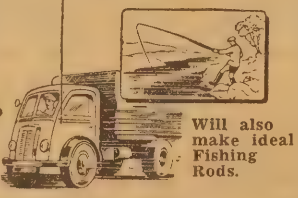
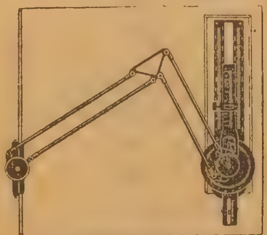
Base to suit Aerial, 9/6 EACH.



Will also make ideal Fishing Rods.

12ft long, 3 sections. Each section 4ft, 22/6. 8ft long, 2 section, 15/-.

R.A.F. PLOTTING BOARD WITH ARM



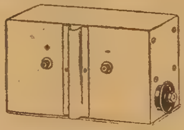
Bakelite Base. Draws Angles Parallel or Vertical.

70/-

IDEAL FOR ENGINEERS, STUDENTS, ETC.

COMPLETE BATTERY CHARGER

Fitted with brand new English Selenium Rectifier.



Works off 230v. Household Supply

Charges any battery from 2 to 6 volts at 4 amps. £6/15/- complete. Also available, 6 or 12 volt Chargers combined. £7/15/-. Charge 2 amps.

IN FIRST-CLASS ORDER

DALTON COMPUTERS, IDEAL FOR AERO CLUB, A.T.C., ETC.

Only Limited Stocks Available. Be Early.

45/-

ENGLISH ARMY SPOTLIGHTS

IDEAL FOR SHOOTING. FIT ONE TO YOUR CAR.

6-volt, 37/6. .. .. 12-volt, 25/-
Fitted with Mirror Reflector.

SPECIAL OFFERS

Khaki berets, leather bound,	5/
Water bottles, complete,	4/
Canvas and leather rifle cases	15/
Best quality bib and brace overalls, navy or khaki	29/11 pr
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Leather Safari jackets,	£6/15/
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All wool khaki socks ..	7/6 pr
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Motor-cyclists' waterproof suits Coats, £4/15/-; Trousers,	£3/3/
Khaki Long top socks	10/6 pr
Fur-lined leather mittens,	37/
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Army sweaters, roll or V neck blue or grey, 29/6; khaki,	39/
Kelvin rubber dairy boots,	35/
All wool Army blankets,	37/
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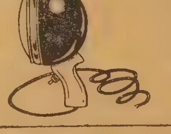
SEALED BEAM SPOT LIGHT

Ideal for shooting. Useful in boat. 22/6 complete.

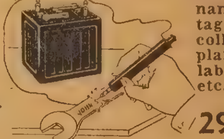


6 or 12 volts. Carry one in your car.

ELECTRIC ENGRAVER

What everybody has been waiti for. An Electric Engraver th works off your car battery.

En-graves any-thing in metal.



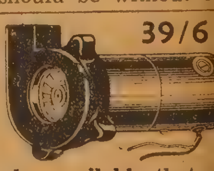
Ideal f name tags. do collars, plant labels, etc.

29/6

Engrave your name on all yo tools. Marked tools are never stol No Garage should be without o

English Motor and Blower, 24 Volts

Will Work on 32-volt Lighting Plants.



39/6

Larger size also available that work off 12 or 24 volts, £3/15

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512 Elizabeth St., Melbourne, C.1
m Victoria Street. Phone FJ 5904
d Efficiently Despatched
Include State in Address

. SPECIAL OFFERS

**Generator Test Meters 35-0-35
ımp meters, 4¼in dial, 45/-; 0-10
volt meters, 4¼in dial, 45/-.
.oading Resistors can be sup-
plied to make volt meter read
.0.20 at 12/6 extra.**

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le: Whistle While You Work;
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y To You; Little Brown Jug;
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alpels, many uses, photo-
aphers, etc, **6/6**. Twist Drill
ts, 1/16in to 3/16in in 9 drills for
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9; Shaded Pole induction motors,
ade by Hoover of England, 230
lts, AC. Ideal for Projectors,
pe Recorders, Fans, etc., **£4/19/6**.
spection Mirrors, Ideal for Mech-
ics, **5/9**. Tapped Transformers,
12, 18 and 24 volts, 3 amps, **39/6**.
0 volts input. Low pressure
ray Guns, **39/6**. American Feeler
uges, **8/6**. Army Steel Tow
pes with looped ends, **17/6**. Army
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aphic work, levels, etc., 41in
ng, **22/6** each. Complete Whit-
orth Spanner Sets, open one end,
ng the other, **25/-** set. 6 span-
rs to a set. English Hair Clip-
rs, first-grade quality, **17/6** pr.
AE open end Spanners, 6 to set,
/6. Whitworth, 4 to set, **18/6**.
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ecial price, **10/6**. Brand new 7/8in
ark Plugs, suit most old type cars,
6 each. Brand new RAAF Life
ckets, kapok filled, **27/6**. 4in
alipers, inside and outside, **5/6**.
rabolic Reflector Mirrors, 3½in,
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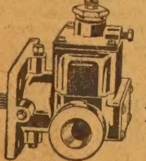
spotlight or for photographic
ork. Bosch Electric Windscreen
ipers, **£4/18/6**. Steel tool boxes,
mplete with lift-out tray, **40/6**.
st quality English carpenter's
ws: 4, 5, 6, 7, 8 and 10 point, **30/-**.
atchmaker's screwdrivers, set of
14/9. Tweezers, **6/6** pr. Pin
ces, **5/6**. Eye glasses, **8/6** each.
tra strong double lens eye glasses
/- each.

AMERICAN FUEL PUMPS



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AINLESS
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WILL
PUMP
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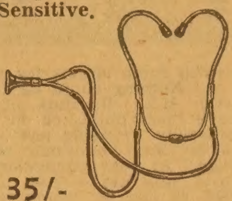
) gals. per hour. In excellent
ler, **55/-**. Brand new, **75/-**.

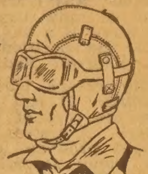
MECHANICS' STETHOSCOPES. Ideal for Testing Engines. Very Sensitive.



35/-

GENUINE AMERICAN FLYING HELMETS

IDEAL FOR MOTOR CYCLISTS AND ALL OUTDOOR WORKERS.

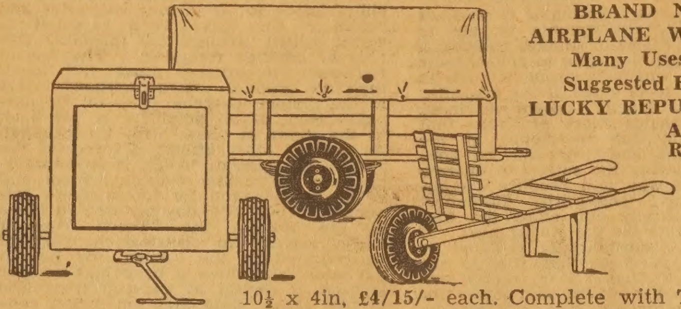


BRAND NEW, 15/- EACH

BRAND NEW AIRPLANE WHEELS

Many Uses as Suggested Below.

LUCKY REPURCHASE AT NEW REDUCED PRICE.

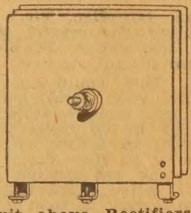


10½ x 4in, £4/15/- each. Complete with Tube.

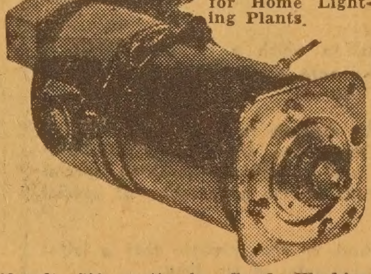
BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger.

**12v. 2 amp, 35/-
6v. 5 amp, 50/-
12v. 5 amp, 79/6
12v. 3 amp, 45/-
6v. 2 amp, 24/6
6v. 4 amp, 45/-**



Transformers to suit above Rectifiers, 2 amp, 37/6; 6 volt 5 amp, 45/-; 12 volt 5 amp, 55/-.



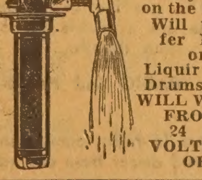
Battery Charging Generators. Ideal for Home Lighting Plants.

**12-volt 500 watt, in Good Working Order £5/-/-
12-volt, 500-watt new £7/10/-
24-volt, 1000-watt. Brand new, £12/10/-**

24-VOLT MOTOR COMPLETE WITH FUEL PUMP

Ideal for Caravans. Takes the place of hand pumps.

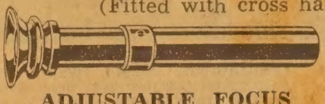
£5



Many uses on the Farm. Will transfer Petrol or any Liquir from Drums, etc. WILL WORK FROM 12, 24 or 32 VOLTS AC OR DC.

ARMY FOCUSING TELESCOPE

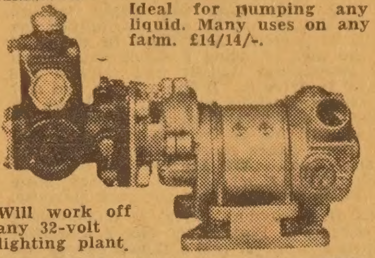
Easily converted for use on dumpy levels.
Can be used as a rifle sight.
Excellent magnification **£4/19/6**
(Fitted with cross hair)



ADJUSTABLE FOCUS

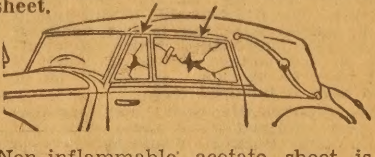
Lucky Repurchase! Aircraft 24 volt motor complete with 400 gal. per. hour pump. Brand new, made in America.

Ideal for pumping any liquid. Many uses on any farm. £14/14/-.



Will work off any 32-volt lighting plant.

Replace those broken side curtains with cellulose acetate which takes the place of celluloid and lasts four times longer. Will not discolor, 32/6 sheet.



Non-inflammable acetate sheet is recommended for all types of side curtain. Sheets are 120 thousandths thicks. Size of sheet, 24in x 52in. Can be sewn or cemented into frames.

BRAND NEW AIR COMPRESSOR

2.2 cubic feet, will pump up to 75lb.

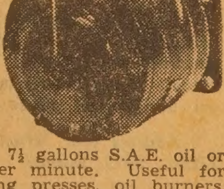
Never before at this price. Spraying.

£11/15/-

Will work off ¼hp Motor.

AIR RECEIVER TANKS, £3/10/-

AMERICAN VACUUM or AIR PUMP



Builds up air pressure to 20lb at 1000 R.P.M. Develops up to 120lb of hydraulic pressure, will pump 7½ gallons S.A.E. oil or other liquids per minute. Useful for spraying, milking presses, oil burners, hydraulic systems **£3/15/-**

ANSWERS TO CORRESPONDENTS

I.D.H. (Smithtown, NSW) wants to know if the regenerative set described in the December, 1952, Radio and Hobbies would be capable of receiving his local station at loudspeaker strength.

A. It is unlikely that you would obtain very satisfactory results I.D.H., no matter how strong the station, because a valve working with such low plate voltage would simply not be able to deliver the required power. And don't be deceived by the idea of using a small speaker on the assumption that it will require less power to drive it. If the scheme had any chance of working at all it would be by using the largest speaker you could obtain, say one of the 12in variety, which are many times more efficient than the smaller ones. We suggest the additions made to this set in the January issue would be most suitable for your purpose.

R.C.M. (Croydon, NSW) is endeavoring to operate a Playmaster No. 2 amplifier from a genemotor and a 32 volt supply but is experiencing a lot of noise troubles.

A. From your description it is difficult to say whether the trouble is due to ripple in the filament supply, causing a hum, or RF radiation, due to commutator sparking &c., which is strong enough to effect the low level stage of the amplifier and which is usually known as hash. However, it seems most probable that the trouble is due to ripple in the filament circuit and this can be confirmed by allowing the set-up to operate in the normal way and produce the interference, then temporarily disconnect the filament supply and allow the filaments to operate on the stored heat. If the trouble is substantially reduced or eliminated it is clear that this is the cause of the trouble. This trouble can sometimes be caused by the power for the genemotor and the filaments running through a common line from the battery and can be cured if a separate line can be provided. It may also be helpful to include an iron-cored low tension choke in the filament line, the type normally used for vibrator sets being suitable. The filament side of this should be by-passed with the largest value of electrolytic capacitance which is available in the voltage rating at which it will have to operate. It should be at least several hundred mfd.

H.L. (Longueville, NSW) mentions that he was informed by a radio firm that Radio and Hobbies would prepare a special radio circuit for a nominal fee.

A.: Nothing could be farther from the truth H.L. Reprints of circuits which have been published in past issues are generally available and will be supplied under the conditions set out on this page. In your particular case, an autodyne superhet circuit using types 6C6, 6D6, 42 and 80, which was published in the November, 1943 issue, may be of interest. There are also some smaller TRF and superhet circuits available.

J.B. (Ashfield, NSW) asks the meaning of a number of radio terms. He would also like to know if a 3V4 could be used instead of the 3S4 specified for the sets in the "Teach Yourself Radio" series.

A.: Fidelity means true reproduction or the original. It can be applied to sound as in the case of radio receivers and amplifiers. A system having perfect fidelity would produce in the listener exactly the same sensations as if he had been at the original performance. "Converter" is frequently used as an abbreviation for frequency converter and refers to the valve as a superhet receiver which changes the incoming signals to another frequency. The second frequency is usually fixed and lower than the original. "Regeneration" refers to the system whereby some of the output energy of an amplifier is fed back to the input in phase with the original. As well as other effects it increases the gain of the system. "AVC" is an abbreviation for automatic volume control and IF an abbreviation for intermediate frequency. Your 3V4 may be used in place of the 354 in the "Teach Yourself Radio" series. No electrical changes will be required in the earlier sets but in the later sets where a back bias resistor is used, it should be reduced from 1500 to 1000 ohms. Note that the socket connections are different.

B.I. (Bendigo, Vic.) says he has just finished the crystal set, but finds that the local station 3BO blots out some other more distant stations.

A. This would not be surprising because your local station is so much stronger than the others. The best plan would be to make up a wave-trap to connect in series with the aerial, and tune it so that the signal from 3BO is as weak as possible. We will answer your letter more fully in the Answer Tom feature as soon as the present series is complete.

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

E.M.W. (Fairfield, NSW) sends i
our comment on the circuit of a 4-
amplifier. He also says he has a nu
of old valves for which he cannot re
find circuits.

A. There are two doubtful points a
your circuit. The two isolating resi
marked ".05" would not allow the vo
controls to be completely indepen
The value should be 0.5 meg. The se
point is that a 6V6 grid resistor sh
be 0.5 meg, not 0.1 meg. Most of
valves you have listed are useful t
many of them having direct octal-
equivalents. If you have a look th
our files next time you are in the
you should be able to find circui
meet your requirements.

J.C. (Scone, NSW) sends 12 mo
subscription to the magazine and
suggestions for articles he would
to see.

A. Thanks for your subscription,
and we have forwarded it to the ap
priate department. Also many thank
your comments and suggestions whic
will keep in mind. There is no
that the 175 Kc IF channel pro
plenty of selectivity, but there is
disadvantage that it does not lend
readily to the ordinary dual-wave
cuit which is sometimes more val
in country districts than a high
tivity broadcast set. We do somet
publish voltage figures but there i
guarantee that the home-builder wi
able to exactly duplicate these u
all his components are identical. In
cases this may lead beginners to be
that there is a defect in their set v
is really only normal tolerance varia
Your case for the Serviceman has
passed on to him for his possible
at a later date.

Mr. H. C. MacC. (Rosslyn Park)
for our comments on a car radio rec
circuit he has designed.

A. While we have no reason to
pute that the set works well on the b
it would not be very satisfactory
installed in a car. The absence o
automatic volume control system w
mean that the volume would vary
tinually with the car in motion.
if the circuit were modified to in
AVC, the lack of an audio voltage
plifier stage would leave the set
of gain for reception under very
conditions often encountered while
velling. Furthermore, it is very
design to use common screen supply
cathode bias for three successive
plified stages. If your receiver is st
it is probably only because full ga
not being achieved. If you are
cularly interested in making a 4-
car radio we can recommend the
which was described in the April,
issue.

H.M. (Christchurch, NZ) encloses
circuit of an AC power supply for
able receivers which he feels may
interest to other readers.

A. Our experience with mains ope
low tension supplies is that extre
large values of inductance and c
citance are required to reduce the
to a reasonable value. Rather than
very large chokes and capacitors,
usually recommend that a small dry
be connected across the output o
supply to complete the filtering. A
ply along these lines was describe
the October, 1948, issue of Radio
Hobbies. As you appear to have
little hum with the small amoun
filtering you are using, all we can
gest is that your receiver is a sp
case and hum fed into the filament
work is cancelled in some way.
are not happy about the use of
transformers as power transformers
less there is a special reason to be
that the insulation is adequate fo
purpose.

J. McH (Toorak, Vic.) asks about p
supplies for the BC455 "Command"
ceivers.

A: Originally, these receivers ope
from 12, 24 or 28 volts and the
tension was obtained from a
generator. As far as we can rememb
delivered 260V at 60mA. An AC p
supply, therefore, would have to de
the same. Your kind wishes are
appreciated.

(Pialba, Qld.) has a commercial
set which is giving trouble and
to know if we can advise what
e the cause.

Vithout some knowledge of the
we regret that it is almost im-
e for us to diagnose the trouble.
act that the volume control has
replaced eliminates the obvious
ion and we can only advise that
btain the services of a reliable
man. If this is not convenient,
ay care to write to the makers,
g them of the exact model num-
d all other details. It is just
e that they may be able to advise
hat steps to take to locate the

(Redfern, NSW) asks a number
estions involving the operation of
t portable receivers.

Your receiver draws 0.2 amps and
you need to drop the filament volt
y 0.5 volts, the resistance neces
will be 0.5/0.2, equals 2.5 ohms
only one valve, the resistance
be 10 ohms, as you suggest. Ap
tly the regulation of the elimin-
s not the best, causing the voltage
p from 90 to 50 under load. Pos
the rectifier valve is weak but
case, eliminators show this effec
than batteries unless the latter are
run down.

(Wellington, NZ) says he has built
aby record player (August, 1950)
nds that it has not quite enough
for his requirements.

ou do not mention the valve which
ad to substitute for the 6M5 but,
appened to be a 6AQ5, there would
noticeable drop in gain. Your best
would probably be to convert the
fier over to the circuit of the "Baby
aster", as featured in the Decem
951, issue.

(Crawley, W. Aust.) forwards a
plifier mixing circuit for possibl
ion in the Reader Built It sectio
magazine.

Thanks, B.H., for your letter. You
t may well be of interest to othe
s and we are holding it with a
le view to publishing it in som
issue.

OFF THE RECORD

(Continued from Page 89)

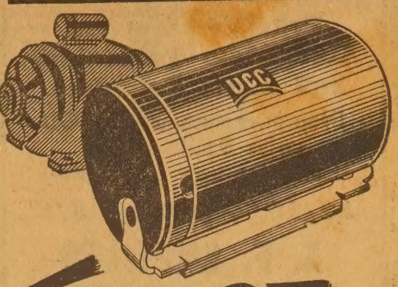
to do it is to hurry. I suspect there is at least as much of Beecham here as there is of Stern.

The recording is very good, and only a shade below the top bracket to which very few records aspire. It tends to become a little clouded on heavy passages in the centre half, and the violin, here and there, could do with a little extra top cut without coming to grief. But these criticisms apply only to wide-range machines, which are particularly fussy about such things.

The general surface noise is quite low—virtually inaudible, in fact. This gives full effect to a good dynamic range. The violin tends to dominate the orchestra if anything, but generally the balance is good. A record you should hear.

TCHAIKOWSKY — Romeo and Juliet Overture, played by the Concertgebouw Orchestra of Amsterdam, conducted by Oaul van Kempen. Philips A 00128 R.

For years there was only one, or perhaps two, recordings of this really striking work of the famous Russian. Whether or not it is due to the discovery of one of its themes by Tin Pan Alley is uncertain, but there are plenty of them today. This one didn't strike me as being in the same musical class as the Brahms record, but it's fair enough. The orchestra is somewhat remote, and the pressing isn't as clean as I'd like. It's a 10in record and, strangely enough, there is no indication on the label as to which side is which, apart from a matrix number in small type.



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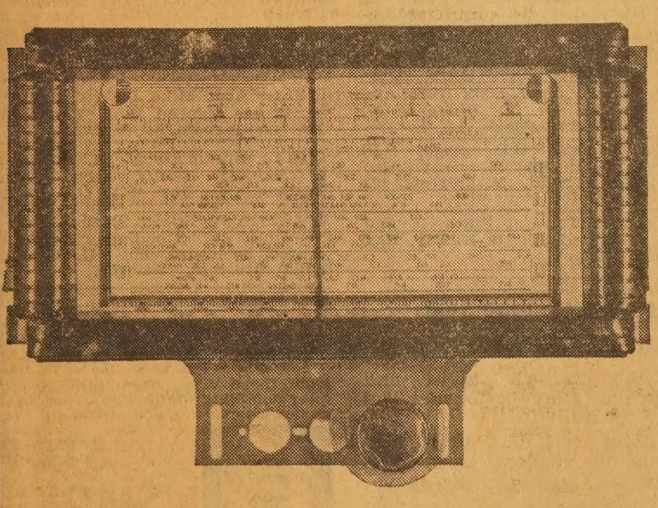

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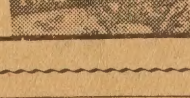

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Wanted to Buy, Sell or Exchang

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for September issue of Radio and Hobbies is Wednesday, August 12.

FOR SALE: Valves, 2 x 1A7-GT, 1 x 1N5-GT, 1 x 1C5-GT, 12/6 each, £3 lot. **J. Johnstone, Graeme St., Aberdeen.**

FOR SALE: Transmitter 20, 40 and 80 mts., 807s final 807 buffer. 750-750 transformer, 75w. No oscillator. Also Modulator 807 PP 6V6, 6J7, 6J7. JT30 Mike, £30. **Holmes, 96 George St., East Maitland. Phone U566.**

FOR SALE: Ferguson 3in Oscilloscope (today's value £55), as new, unused, £40. Also FS6 Transceiver, brand new, with Cables, Plugs, and 6V Vibrator Unit. £20. Sell both together for £50. **Lewis, Box 123, Cowra, N.S.W.**

FOR SALE: Bendix Freq. Meter modulated—240V. A.C. operation, with manual—perfect condition, £45. Sulivan resistance capacity bridge, .0001 to 10 mfd. 30 ohms to 3 meg., £15. **99 Stoney Creek Rd., Beverly Hills, N.S.W. LU3125.**

FOR SALE: AR8 receiver with speaker and 12-volt power supply. Best offer, **A. Bailey, Narracan, Vic.**

FOR SALE: Bed Warmers for sale, 10 new, 32, 110 and 240 volts, AC or DC. Can be left on all night for one unit a week. £2 each, P.P. 3/-. Also 0-10 micrometer. **R. Mooney, 78 Rundle Street, Rockhampton, Queensland.**

FOR SALE: University Multimeter and Signal Tracer, plus assorted radio parts. Apply **XW6338.**

FOR SALE: New Six-valve Radio with R.F. stage and 8in speaker. Console Cab., £25. New 5-valve set in leatherette table Cab., 5in speaker. Excellent performer, £21. Two Scope Soldering Irons, only used for few months. In good order, without Trans. What offer? Freight paid on all goods. **P. Gatehouse, Milton, NSW.**

SELL: AR7 Receiver (modified), £32/10/-, B.F.O. 50c—12kc, £10. New Grammo motor & pick-up, £4. Pair 807's, 30/-. 1625's, £1. 3in Weston Meters, 30/- ea. **FF3600, 3 Harbourne Rd., Kingsford.**

SELL: Type 3 Mark II with Modulator and Spares. Good. £35. **Butler, Bayview Rd., Frankston. Phone Fkn. 1408.**

SELL: R. and H. for 8 years from Ap., 1939. The lot for £6. Write to **N. Ward, 74 Ainslie Ave., Reid, A.C.T.**

SELL: 30.w. audio O.P. stage, P.P. parll' 2A3's with Hi-Fid. transf. Also 2 chokes 300 m.a. 20.H. **N. Shirrefs, 462 St. Kilda Rd., Melb.** Any night.

SELL: Variable Top-Cut Filter, R. and H. Circuit Tested, £5. **B. Hickey, Box 35, Emerald, Qld.**

SAVING FILMS

(Continued from Page 7)

journals (the quarterly Sight and sound, and the reference-journal The Monthly Film Bulletin).

It maintains constant contact with professional film-makers, and it does not ignore the amateur film movement, out of which can come interesting experiments.

The loan section of the National Film Library enables film societies, schools and other interested audiences to borrow older films of historical and artistic interest at low rates of hire for its members.

The institute offers various grades of membership with various kinds of service, and in 1952 the institute had 22,000 members and associates.

But the greatest single achievement of the British Film Institute since the war has been the founding of the National Film Theatre in the small cinema built on the Festival of Britain site.

SELL: Byer R.33 Disc Recorder,
with Acos GP20 and Byer tape
separate tape amplifier. 2 Byer xtal
and level indicator. Gears for int
or reverse feed, and for MG reco
5 std and 3MG cutting sapphires,
12in, ½ doz. 10in blanks with bags
labels. Goldring playback unit in
3 Reels Tape, Table mic stand. New
dition, slightly used. Worth £400.
sale, £285, or best offer. **C. H. Ma**
16 Stewart St., Colac, Vic.

SELL: Transmitter BC191-C, 6.2
meg.; Admiralty receiver, 550
23 meg., in 5 switched bands, 240
MN26C Compass receiver; Wave
Class C; 3in C.R.O. by H.M.V. with
cuit. What offers? Consider ca
trade in. **109 Devonshire St., Sy**

SELL: Back numbers Radio & Ho
Buchester, Mametz St., Yeerong
Qld.

SELL: Goodmans Axiom 150 Spe
used few hours only. £16½. 39
North Rd., Five Dock. UA2838.

SELL, Cheap: 3 and 8in Speakers,
and vib. trans.; Goldring and H
P.U's, var. speed motor; var. c
valves. **JX1546.**

SELL: Axiom 150, £10. SC R
Changer Acos Head, £12. I
walnut vented baffle for two spea
£18. **JA8647, 10 Lamette St., Chats**

EXCHANGE: American Spanish G
for Tape Deck. **10 Seymour**
Camberwell.

WANTED: Signal Generator, Osci
and Signal Tracer. Particulars
Graham, Arcadia Vale, via Toronto,

WANTED: Maintenance Book ins
tions, Bendix Radio Compass.
22 Batty St., Rozelle.

WANTING: Transceiver suitable
small ship, required to cover ap
to 7 megs. **Please Phone JJ2384 or M**

SELL: 16mm. Aircraft Movie Ca
24V. type G.45. 2in F3.5 lens,
mag. Good condition. Ideal remote
trol. £10. **Argue, 23 Mount St., Arn**
N.S.W.

SELL: Acos Mike Inserts, new, us
£3 ea, reduced 35/-. **Phone MX**
126 Buckingham St., Sydney.

SELL: Bradmatic Megn. Sound H
5RP/5E, £6/6/- each. **Gemi**
Trading Co., Box 4848, G.P.O., Sy

SALE: Two Speed Studio Type T
table, £16. Goodmans Axiom 1
vented enclosure, £18. **H. Young,**
della Crescent, Narwee.

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